SCIENTIFIC INVESTIGATION AND PHYSICAL EVIDENCE

A Handbook for Investigators

LELAND V. JONES
Assistant Professor of
Police Science
Los Angeles State College

Edited by E. CAROLINE GABARD. "The author feels that a better understanding of criminalistics will help investigators in obtaining the greatest possible assistance from the laboratory, and he hopes that this book will contribute to that understanding."— From the Introduction

Two leading thoughts guided the author in his writing: 1. The extent to which the laboratory can aid the investigator. 2. Limitations of the laboratory.

CHARLES C THOMAS • PUBLISHER • SPRINGFIELD • ILLINOIS

SCIENTIFIC INVESTIGATION AND PHYSICAL EVIDENCE

A KNOW-HOW COURSE on tested and tried methods and procedures for

- Recognizing
- Gathering
- Marking
- Preserving
- Packaging

physical evidence and presenting such materials in courts of law.

Professor Jones writes with the authority of over 28 years' experience in the oldest forensic laboratory in the United States--the Los Angeles Police Department's Scientific Investigation Division (founded 1923). Out of the author's broad personal experience with some 10,000 cases and over 2,500 appearances as an expert witness in court comes a vast store of criminalistic laboratory knowledge for the crime investigator and police officer--in fact, for the entire field of investigation.

An expert answers your thousand-and-one needs in a comprehensive, clearly written handbook worth many times over its small price.

SCIENTIFIC INVESTIGATION
AND
PHYSICAL EVIDENCE

SCIENTIFIC INVESTIGATION AND PHYSICAL EVIDENCE

A HANDBOOK FOR INVESTIGATORS

By

LELAND V. JONES

Assistant Professor, Los Angeles State College
Formerly, Instructor, University of Southern California
Formerly, Commander of the Scientific Investigation Division
Los Angeles Police Department
Los Angeles, California

Edited by

E. CAROLINE GABARD

Instructor, Police Research and Bibliography
Los Angeles State College

CHARLES C THOMAS · PUBLISHER
Springfield · Illinois · U.S.A.

THOMAS BOOKS
SYMBOL OF LEADERSHIP

CHARLES C THOMAS • PUBLISHER
BANNERSTONE HOUSE
301–327 East Lawrence Avenue, Springfield, Illinois, U.S.A.

Published simultaneously in the British Commonwealth of Nations by
BLACKWELL SCIENTIFIC PUBLICATIONS, LTD., OXFORD, ENGLAND

Published simultaneously in Canada by
THE RYERSON PRESS, TORONTO

Library of Congress Catalog Card Number: 58-14078

Printed in the United States of America
Cape Girardeau, Mo.

DEDICATION

To the Scientific Investigation Division of the Los Angeles Police Department, and, in particular, to Thad Brown and to Raymond H. Pinker, with whom I was associated for twenty-one years.

L.V.J.

INTRODUCTION

This work has been written primarily for the investigator, and is an attempt to assist him in recognizing, evaluating, marking, and preserving physical evidence, and in presenting such material in courts of law. The author hopes, also, that the book will be of use to the policeman on patrol, who, in many of the smaller communities, is the investigator, and who, in larger cities, must preserve and protect the scene.

The book deals with techniques of scientific investigation, many of which have been developed by the Los Angeles Police Department's Scientific Investigation Division and other divisions of the Detective Bureau, and are now standard practice within the Department.

Two thoughts have been uppermost in the author's mind during the writing of this book: one, the extent to which the laboratory can aid the investigator; and two, the limitations of the laboratory. The author feels that a better understanding of criminalistics will help investigators in obtaining the greatest possible assistance from the laboratory, and he hopes that this book will contribute to that understanding. The author has deliberately avoided highly technical material, which is sufficiently treated in other works, and has attempted to present data which will be of interest to the entire field of investigation.

ACKNOWLEDGMENTS

The author wishes to thank DeWayne A. Wolfer, Charles E. Gabard, Oak K. Burger and Reed McLaughlin, who contributed to Chapters VI, VIII, XIV and XVI, respectively. The author also wishes to thank his wife, Frances H. Jones, his secretary, Margaret C. Molkenbur, and Jack Carter for their assistance in preparing the manuscript. The author also wishes to thank William H. Parker, Chief of the Los Angeles Police Department.

CONTENTS

SCIENTIFIC INVESTIGATION AND PHYSICAL EVIDENCE

I

EVALUATING PHYSICAL EVIDENCE

Scientific investigation may be defined as the application of science and scientific equipment to compare, analyze, or identify matter for presentation in courts of law. This field is eclectic in that it annexes applicable techniques and processes from the many physical sciences. It also includes the ability to recognize and segregate various objects that may have evidential value. To be a good investigator, one must have imagination. One must be able to see the potentialities of evidence which others may overlook.

In the larger city which maintains a crime laboratory, an expert often goes to various crime scenes and works in conjunction with the detectives. This enables the expert to receive the evidence at the scene, often eliminating those articles of no evidential value without taking them to the laboratory. Spot analysis at the scene is time saving.

Many smaller towns are not so fortunate. They may be so remotely situated that they do not have ready access to a well-equipped laboratory. It is the objective of this book to set forth methods and procedures for recognizing, gathering, marking, preserving, packaging, and presenting physical evidence in court. Much of this information and many of these methods have been developed by members of the Los Angeles Police Department's Scientific Investigation Division through research and experimentation.

Physical evidence is of value only if it helps to prove a case or if it aids in clearing a suspect. The most valuable physical evidence may be worthless if inefficiently handled.

The handling of physical evidence may be divided into four phases:

1. Gathering all potential evidence at scene or elsewhere.
2. Marking it correctly.
3. Keeping the chain of continuity straight.

4. Preventing contamination.

Each phase is of equal importance if such evidence is to be accepted by the courts.

Laxity by the investigator in any one phase may nullify not only his own work but also that of others.

There is nothing more discouraging or embarrassing to an officer than to have a vital piece of evidence barred by the courts because of his own negligence. The first phase, that of gathering all potential evidence, is probably the most difficult as there is no set of rules that will cover all the possibilities. Hair, fibres, dust, dirt, and debris may be easily overlooked. Even larger objects may be overlooked through inability to recognize their evidential value.

Sometimes a piece of evidence may be so conclusive that standing alone it will sustain a conviction. At other times it is only after presenting many articles of possible evidential value to the laboratory for analysis that the investigator has enough to prove his case.

It is not always possible to know whether or not an object has evidential value until it is analyzed. One is generally unable to see all the detail in a shoe imprint until a cast has been made and that cast compared with the shoe. For this reason, whenever there are many imprints, many casts should be made. Plaster is cheap, especially if it proves the case.

It is easy to discard or return objects proven to be valueless as evidence, but it is often impossible to find things carelessly passed up during the initial investigation. The piece of glass one failed to pick up at the scene of a hit and run may be the only one lost in that vicinity which will fit mechanically with a piece remaining in the headlight of a suspected car.

One must look for the things which are out of place—the things that do not belong—a button, a bolt, a broken part of a handle, a scrap of paper. Nothing is too insignificant.

No matter how airtight a case may seem, all such objects should be saved until they are definitely eliminated as possible evidence. "Airtight cases" have a habit of "blowing up."

One must approach each case with the theory that everything will have to be proved. Often an investigator extracts a complete confession from a suspect and relies primarily on that to prove

his case, only to have that confession thrown out at the trial. The experienced detective foresees such a possibility and will generally have other evidence, if such exists, to substantiate his case.

The second phase, that of marking physical evidence, will be discussed in more detail in subsequent chapters, thus it will suffice here to speak only in generalities. The rules of evidence are exacting. Even though the judge may believe that a certain blood-stained pipe is the murder weapon, he will bar it as evidence if the investigator cannot say when and where he obtained it.

One should never use an "X" as an identifying mark. It is too easily duplicated. Initials or another such identifiable mark should be placed on the object and a record made in the investigator's notebook, giving the mark used and its location. All marks should be small and inconspicuous. Any object, before being marked, should be carefully examined and the identifying mark placed so as to avoid destroying possible evidence. If it is impractical to mark an object because of its minute size or other characteristics, it should be placed in a glass vial or a cellophane envelope, sealed and the container marked.

The primary reason for marking an article is to enable its finder to later identify it in court. If there are other means of identification—serial numbers, cigarette burns, scratches, et cetera —it may not be necessary to place a mark on the object providing all such information is entered in the investigator's notebook.

The third phase is that of keeping the chain of continuity straight. The investigator must remember from whom he received an object and to whom he delivered it. A chain with one broken link is generally worthless. Sealed evidence may pass through a number of hands without materially weakening its value if the seal remains unbroken, but even then, the fewer handlers the better.

An investigating officer should be accurate when testifying in court as to the exact part he played in gathering the evidence. He should state whether he actually picked up some specific object himself or whether it was found by some one else in his presence. This may appear to be of little consequence, yet any discrepancy in the testimony of a witness, no matter how insignificant it may seem, will be an added tool for the defense.

If an officer states that he found a marihuana cigarette in the

right coat pocket of the defendant, when in reality it was the left pocket, or if he miscounts the exact number taken from some specific place, the defendant will know that he has erred, and will pass such information to his counsel.

Evidence should never be handled by parties not connected with the case unless such evidence is sealed, or unless all persons so handling it are subpoenaed into court.

Evidence should be presented in court in the exact shape and condition in which it is found whenever it is possible to do so. Exceptions can be made when certain analysis of the evidence is necessary: even then, changes should be explained by the expert making the analysis. It is generally good practice to photograph the object if its appearance will be materially altered through analysis.

The ideal procedure, and the one which eliminates unnecessary handling of evidence, is to have the laboratory expert aid the investigator at the scene, thus all potential evidence can be submitted to him at that time. It should remain in his possession until it is eliminated, booked, or used in court. This procedure has another advantage, in that the expert may eliminate many articles at the scene through chemical tests or by the use of a good low-powered microscope. Such tests at the scene are an added factor when the time element is essential.

The fourth phase is preventing contamination of the evidence. All too often physical evidence is injured or even destroyed before the investigator arrives. This may be due to the carelessness of curiosity seekers or of officers themselves. Footprints near a dead body may be obliterated by over-zealous on-lookers or by newsmen anxious to get a scoop for their paper. Lethal weapons may be moved from their original position before they can be photographed, and, in some cases, articles of great evidential value have actually been stolen from the scene. These conditions apply not only to homicide but also to such cases as burglary, hit and run, et cetera.

The owner of a burglarized safe is primarily interested in what was taken, and, if not prevented, may start an immediate inventory to ascertain his loss. Footprints on papers strewn in front of the safe or fingerprints on various objects within the safe may be obliterated by this carelessness.

It is the responsibility of the first officer at the scene, whether he is in uniform or plain clothes, to protect that scene until sufficient help arrives, or until he is relieved of duty.

Although newspaper reporters have aided police in solving many criminal cases, they may inadvertently contaminate or destory evidence. Nothing is sacred to a few of them if it will increase circulation. As an example: a heelprint was found near the body of a murdered woman, and from the location it was almost a certainty that it had been made by the shoe of the perpetrator. Newspaper men present at the time it was found definitely stated that they would not divulge the fact that such evidence existed, yet within twenty-four hours *one* paper carried headlines giving all the information. It stands to reason that the killer, after reading the article, discarded his shoes immediately. Criminals are avid readers of the newspapers after they have pulled a job, for they know that is their best source of information as to what the police know.

We all agree that newspaper men have a job to do, but so do the police. No officer should divulge information that might hinder him in solving the case, just to satisfy the morbid curiosity of newspaper readers.

This is not written in condemnation of newsmen, but to emphasize the necessity of every officer at the scene of any crime being alert. The same person who may have destroyed the evidence will be the first to castigate the officer for inefficiency when he fails to catch the criminal.

Many times the mere fact that the perpetrator of a crime is aware that certain articles exist, or that they have been found, may nullify their value as evidence, especially if these articles are to be compared with others in his possession. He would certainly destroy anything that could be used for comparison—clothes, shoes, tools—or he will prepare alibis to explain their existence.

The investigator should also bear in mind the possibility of destroying or contaminating evidence before it is noticed or recognized. Minute spurts of blood, particles of dust, dirt, and debris are not always obvious to the naked eye and can be destroyed or rendered worthless as evidence if he is not sufficiently observant during his investigation.

He must be systematic in his approach, covering each step

thoroughly before moving to the next, protecting all evidence as it is found. All information should be entered in his notebook while it is still fresh in his mind.

Bullets have sometimes been carried in the pockets of investigators for days before they were submitted for analysis. If the identifying striations through which comparisons are made are not destroyed, there is at least the possibility that adhering, sometimes microscopic, debris such as blood, pieces of bone, hair, or tissue may be lost.

Bullets, shells, et cetra, recovered at the scene or turned over to the officer at the morgue should be marked and then placed in a container. A glass vial or a cellophane envelope is preferable but if neither is available the articles should be wrapped separately in a clean piece of paper, secured with a rubber band or string, and then placed in an envelope. If the envelope is to leave the officer's possession before it is entered in court, it should be sealed with red sealing wax and the officer's thumb print placed in the wax.

Articles to be compared should never be placed in the same container even though separately packaged: in other words, glass found at the scene of a hit-and-run and glass taken from a suspect's car should be packaged separately. Debris from the clothing and confiscated marihuana cigarettes should *definitely* not be placed in the same container even though each is separately packaged and sealed. A jury may be led to believe that a possibility of leakage from one package to the other existed, even though such was impossible.

One of the advantages of packaging small objects in glass vials is the ease with which they may be examined under a low-powered microscope without removing them from the container. For example, paint from the clothing of a hit and run victim may be compared both macroscopically and microscopically with paint taken from cars found in the possession of various suspects without chancing loss.

Tools should never be brought in contact with or fitted into any suspected mark on the premises of an illegal entry. To so do may destroy identifiable striations in the marks themselves or, if paint were later found adhering to the tool, it would be valueless as evidence.

A suspect should never be returned to the scene of a crime without first being made to change all of his clothing, including

his shoes. Thus, if through examination of the clothes valuable evidence is found, the defense cannot claim that it got there when the defendant was taken to the scene by the investigator.

If the crime is one of violence, such as assault or murder, and if blood on the person of the suspect would be of value as evidence, his body should be examined and his fingernails clipped before he is taken to the scene.

In picking up any object of possible evidential value an officer should keep in mind the importance of the following:

1. The possibilities of fingerprints being found on it.
2. The chances of certain pieces of microscopic debris, such as hair, paint, fibres, et cetera, adhering to it.
3. How that article should be moved, marked, packaged, and transported, with the least chance of having such evidence destroyed or contaminated.

Carelessness has ruined many cases. To enter the scene of a crime and promiscuously handle objects, open or close drawers, or move papers before they have been photographed and examined for fingerprints is unforgivable.

Physical and Circumstantial Evidence

Even though courts classify both physical evidence and circumstantial evidence as indirect testimony, there is a vast difference between the two. Physical evidence is something that is concrete, something which can generally be measured, photographed, analyzed, and presented as a physical object in court. Circumstantial evidence is, as the name implies, a specific circumstance. For example a suspect is accused of burglary, and the shoes he is wearing are proved to have made certain impressions found at the scene of a crime. The shoes and the imprints are physical evidence, while the fact the suspect was wearing the shoes when arrested is circumstantial evidence. Some one else could have worn the shoes at the time the burglary was committed, therefore that type of evidence is not specific as are the shoe and the imprint. The relationship of the latter is absolute.

It is well for the officer to establish asserted ownership of the suspect's clothes and all objects in his possession at the time of arrest. Thus, if damaging evidence is later found on these clothes or objects, the suspect cannot deny ownership.

The value of physical evidence is based upon the law of

probabilities—just how great are the possibilities of duplication? The rarer the chances of recurrence the more valuable the evidence becomes.

A lone piece of evidence, because of its great intrinsic value and the improbability of its being duplicated, may be sufficiently important to warrant a conviction—for example, a fingerprint. At other times it may be a combination of a number of pieces of physical evidence, none of which are conclusive, that proves the case. A number of individual observations which are singly of low evidential value, yet which all point to the same conclusion, can be just as important and conclusive as a fingerprint.

Many applications of the law of probabilities may be utilized by the expert to evaluate the physical evidence when he presents it in court, providing the prosecutor is familiar with the techniques of getting such testimony admitted. Testimony of a technical nature should be presented to the jury in a language they can understand. To bombard them with intricate problems in higher mathematics will only tend to confuse them and may do more harm than good. Remember the chance of getting twelve mathematicians on any one jury is probably as rare as the evidence involved.

The average juror may have little difficulty in recognizing and evaluating objects pertaining to his everyday life if they are called to his attention. He will probably recognize the fact that during one's entire life he may never see another individual having street clothes identical with his—the same hat, shirt, tie, suit, socks, and shoes. This of course does not include uniforms. Yet in all probabilities the articles mentioned are not unique and hundreds of duplications of each have been manufactured. Demonstrative analogies such as this may be presented by the prosecutor during his summation of the case, or may be utilized by the expert to aid him in explaining the law of probabilities.

The expert can effectively demonstrate the law of probabilities through the use of a pair of dice. To clarify—if a pair of dice is cast, the chance that a six will come up on each is one chance in thirty-six. The same relation will hold true for each cast of the dice, yet the chance of two sixes coming up four times in succession is one chance in 1,679,516. That they will come up five

times in succession is 60,462,576; six consecutive times is 2,176,652,736 yet each time the dice were cast the chances were only one in thirty-six. This can be compared to a number of pieces of physical evidence each of small evidential value.

The following case will illustrate how the law of probabilities was actually applied to just such a case. A certain store was burglarized and the following facts were established:

1. A burglar climbed some pipes at the rear of a building; the pipes were painted red.

2. He crawled across the roof and climbed over a wall, leaving fabric marks showing a ten to the inch weave and a twelve to the inch weave.

3. He left footprints that were made by a size six shoe, having a cuban heel and a metal tap on the toe.

4. He entered a light well and broke a hole through a wall coated with cream colored plaster.

5. He then crawled through an attic, thus gaining access to the store. There previously had been a fire in the attic, which had charred the lath.

6. A sum of $1250.00 was taken from the safe of the burglarized establishment.

The next morning a suspect was arrested and the following evidence gathered:

1. Red paint was found on his shoes, the same color and texture as the paint on the pipes at the rear of the building.

2. He was wearing a jacket having a weave of ten ribs to the inch, and trousers twelve to the inch.

3. His shoes were size six and had a cuban heel and a metal tap on the toe.

4. Cream colored plaster, identical with the plaster on the wall, was found in his trouser cuffs.

5. Small slivers of charred lath were removed from his clothing.

6. He had $992.00 in his possession. He had paid $270.00 on his car at 9:00 a.m. of the morning of his arrest, making a total of $1262.00 in his possession earlier that day.

No single piece of this evidence is necessarily conclusive standing alone, yet taken collectively the chances of duplication would

be improbable. In presenting the evidence in court the expert assigned a conservative numerical value to each category. For instance, that one person out of each one hundred has red paint on his shoes the same as that on the pipes, and that one out of each one hundred is wearing clothes with a weave of ten to the inch and twelve to the inch. That one out of each one hundred is wearing a number six shoe, with a cuban heel and a metal tap on the toe. That one in each one hundred has cream colored plaster in his trouser cuffs, the same color and texture as that from the wall. That one person in one hundred has pieces of charred lath adhering to his clothing, and finally, that one person in each one hundred has in his possession, plus what he spent that day, a sum which adds up to approximately the amount taken in the burglary. Certainly these figures are conservative, yet the chances of finding one individual having all these various pieces of physical evidence would be one chance in a trillion, the product of 100 x 100 x 100 x 100 x 100 x 100.

It is common practice for a defense counsel to minimize the value of physical evidence, especially where the various pieces are of small evidential value. He will emphasize the fact that no single piece of the evidence proves the case. That is why it is so important that the jury realize the significance of cumulative evidence.

A jury, many of whom have little scientific training or knowledge, may have difficulty in understanding and evaluating evidence of a technical nature, no matter how conclusive it may actually be. The presentation of such evidence requires the cooperation of the investigating officer, the expert, the prosecutor. and the judge, and when any member lacks the necessary ability the case may fail.

The investigating officer is charged with the duty of gathering all the evidence, seeing that the witnesses are subpoenaed, and supplying the prosecutor with all information pertaining to the case.

The expert's duty is to analyze the evidence and to clearly and concisely present his findings on the witness stand in language which a lay jury can understand. The prosecutor must be able to utilize the physical evidence in such a way that the jury can see its significance and can understand its implications; the judge must be able to recognize the value of physical evidence and to

see its potentialities. He must be able to clearly differentiate between that which is admissible and that which is inadmissible. It is not uncommon for a judge, through lack of scientific knowledge, to exclude pertinent evidence, even though it definitely should be admitted.

Juries frequently have difficulty in seeing the significance of such evidence as a tool mark and the tool that made it, or the identity of a marihuana seed, merely because it is of microscopic size. It is difficult for them to understand or believe something they cannot see. Yet it is far better that the expert present his findings through the use of photography than to bring a microscope into court. Seldom does one find twelve jurors that are familiar with the use of a microscope—generally one or two of them have never even looked through one. A juror does not wish to appear stupid so he may go through the motions of looking but may not see. Later in the jury room he may deny the presence of that which he was supposed to have seen.

The author had just such a case wherein the prosecutor insisted that a microscope be brought into court in order that jurors might see for themselves the red paint on the soles of the defendant's shoes. Two women jurors went through a cursory motion of looking, but apparently saw nothing, as they later were instrumental in hanging the jury.

The greatest difference between the striations in a tool mark and the furrows of a freshly harrowed field is a matter of magnification. Enlarge the former to the size of the latter and the irregularities will be just as pronounced.

If a billiard ball were to be enlarged to the size of the earth, irregularities on its surface would be more pronounced than those on the earth itself. There would be protrusions higher than the Himalyas and depressions far greater than the Mindanao deep.

Few people would hesitate to testify, under oath, as to the identity of the largest known seed, a coconut, yet a marihuana seed magnified to the size of a coconut is just as distinctive in appearance and it has characteristics which are different from any other seed. Again it is a matter of magnification.

Two pieces of paper torn apart may seem easy to duplicate. Yet if one were to try to match either by tearing other pieces, he

would find it an impossibility. He could never get an apparent match which the microscope could not detect as an error.

The law of probabilities may also be applied to heel prints and actual numbers assigned to their identifiable characteristics. Such things as make of heel, cuts, torn edges, wear pattern, or torn nail holes all have an intrinsic value and may be set up mathematically. To illustrate:

There are many types of heels and the mere fact that the defendant is wearing a certain type is one factor. Again there are many sizes and shapes and a numerical value may be assigned to these. There are many degrees of wear between one that is new and one that is badly worn—a numerical value may be assigned to these variations. The fact that a small piece of the heel has been chipped away may be given a numerical value: in other words, that mark on the heel is accidental and could have been on any portion of the wearable surface; furthermore it is peculiar to that particular heel. The mere fact that it is in a specific place makes it significant, and the factor may be found by dividing the surface area of the mark into the total area of the tread surface of the heel.

The law of probabilities may be applied to a piece of paint consisting of a number of layers of varying thicknesses.

Crime Scenes

There are generally one or more vertices to a crime, in other words high points in the case. They may be the location of the body in a murder, a prior fight in an alley, the home or car of the suspect, et cetera.

The intrinsic value of physical evidence often depends on its location; in other words, its proximity to one of these vertices. A hat on one's head has little significance yet if it is found beside a murder victim it may become of great importance.

Stolen articles on a suspect's person may be more valuable than those found in his room. He may be able to explain the latter but the former will not be so easy.

Presentation of Evidence in Court

The primary objective of giving testimony in court is to present the facts as the investigator found them, clearly, concisely,

and without prejudice. It is generally impossible for an officer to feel completely unbiased after spending much time on a case, and while knowing positively in his own mind that the suspect is guilty of the alleged crime; yet he must not allow that feeling to alter to the least degree his presentation of evidence. He must testify as to what he saw, heard, and knows to be facts. He should not try to embellish his testimony with extraneous material; if some portion of his investigation may seem to aid the defendant, he should not hestitate to testify as to those facts. If the jury can feel that he is perfectly honest and what he has to say are the facts as he found them, they will have a greater tendency to give weight to that portion of his testimony which tends to prove the defendant guilty.

As an example, in a homicide case the defendant claimed that the blood on his clothing came from a nose bleed. The blood from the victim, the blood on the defendant's clothing, and the defendant's own blood were typed. They were all found to be Type O, and the expert so testified in court. If he had failed to type the defendant's blood and had testified only to the victim's blood and the blood on the suspect's clothing, and if it later had been brought out by the defense that the suspect also had Type O, his testimony would have been greatly weakened in the eyes of the jury—they would have had the impression that he was trying to conceal an important fact. The unbiased presentation of his findings gave greater credence to this subsequent testimony, through which he was able to show that the blood spurts on the clothing, even though the same type as the blood of the defendant, came from a foreign origin, because of their directional pattern.

All information gathered during his investigation of the case should be entered briefly in the investigator's notebook, with time, date, place, and persons present. These notes will aid him in giving his testimony accurately.

An officer has to sell himself. He must make the jury believe that he is honest and sincere. The best way to impress them with his honesty is to be honest—and with his sincerity is to be sincere.

The officer must not let the defense attorney cause him to lose his temper. The more caustic and sarcastic he becomes the more tendency there is for the jury to sympathize with the officer.

He must not allow the defense counsel to stampede him into an answer. He must take his time, must think before he answers, and must be sure that he is making a correct statement; above all, he must not be afraid to say *"I don't know."* He cannot get into trouble by saying "I don't know," but many a witness has been embarrassed by professing to know that which he does not know.

Clever defense attorneys may tie two or three questions together, and an answer to one is an answer to all. The officer may protect himself against such a multiple type question by stating "If you mean . . .," then stating that portion of the question which is true, "the answer is 'yes' " or " 'no' " as the case may be. If a question is not clear, the officer should ask to have it repeated. He cannot intelligently answer a question he does not understand.

If an officer feels that he can better illustrate his point through the use of a blackboard, he may ask that he be permitted to do so. It may aid him to clarify his testimony. Jurors are laymen—they are not familiar with the criminal as officers know him. They are hesitant to believe that the clean-cut, fine looking individual seated before them could be guilty of such a heinous crime as murder, rape, robbery, or burglary.

Before the prosecution of the case begins, an officer should be sure that he has all the physical evidence in court, and that he has laid it out in chronological sequence for the district attorney, apprising him of the contents and origin of each package. The district attorney will then be able to present the evidence systematically and the jury will more clearly understand its significance.

The trial is the climax of the investigation, and, whether the defendant is convicted or released, it is a source of satisfaction to the investigator to know that he has presented his case well, and to the best of his ability.

II

COMPARATIVE ANALYSIS

This chapter discusses the technique used in the comparison of:

1. Tool marks—marks made by screw drivers, pinch bars, hammers, bits, and other instruments which are often used to gain illegal entrance to safes, strong boxes, buildings, et cetera.
2. Torn pieces of cloth or paper, broken ornaments, and other objects severed by force or breakage.
3. Pieces of wire or metal that have been broken (contour comparison) or severed by various instruments, such as wire cutters, bolt cutters, knives, hatchets, can openers, scissors, et cetera.

It also includes, but is not limited to, the comparison, through grain or contour, of pieces of wood from the same origin; of marks made by planers and stamp machines; and of cuttings from bits. In other words, it is a comparison of two objects which have similar marks or characteristics in order to determine whether or not they are of a common origin.

The comparison of bullets also falls into this category, but this subject is discussed in the chapter on Firearms Identification.

Tool Marks

A tool mark may be briefly described as the mark left by an instrument or an object composed of a harder substance coming in contact with and leaving some characteristic mark or impression on a softer medium. Tool marks may show one of two things: 1) a negative reproduction of the tool itself—size, shape, contour, and so on—which is a true impression; 2) a series of parallel striations caused by dragging the tool or instrument across the surface of the softer medium.

It may be well to enumerate some of the possible ways that tool marks may be produced:

1. In striking a safe, a hammer may leave a dent similar to the contour of its face, or, if it strikes with a glancing blow, minute scratch marks, or striations, caused by the irregularity of one of its edges.
2. A screw driver or pinch bar used as a pry on a wooden surface (for example, in opening a window, door, or desk drawer) may leave impressions of both faces of that tool, or may leave a series of striations which represent the characteristic edge or edges, dependent upon the way in which it was used.
3. Pieces of wire, padlocks, hasps, when cut by a sharp instrument such as a pair of pliers, side cutters, bolt cutters, or a knife, generally have identifiable characteristics on the cut edges.
4. In the manufacture of wire, striations are made on the outside surface as the wire is drawn through the machine.
5. Heads of tacks, nails, and other stamped articles, may have die marks which were made by the machine that produced them, each die being diffierent from all others.
6. Chips from holes bored through wood with a brace and bit may have circular striations on them caused by the cutting edge of the bit. The holes in the board are of little value, except to show size.
7. Marks left in wood by an axe or plane often are identifiable.
8. A punch used to drive out the spindle of a safe may leave a negative reproduction of the end of that punch, or may glance, thus leaving striations caused by one of its edges.
9. Chisels used to cut bolts, rivets, et cetera, may be identified through characteristic striations left by the cutting edge.

To cite some cases where such types of physical evidence were of great evidential value, we may list the following:

1. The bumper of a car, scraping the side of a building after a liquor burglary, left identifiable marks later used to prove that the car had been at the scene.

2. An imprint found in the trunk compartment of a car was proven to have been made by a specific safe, as each irregularity on the back of the safe was impressed into the composition floor mat of the car.

3. A business establishment was burglarized and a considerable sum of money stolen. It was definitely an inside job, as entrance was gained by some one having a key to the establishment. Three members of the firm had keys. These keys were examined and it was possible to show that a duplicate had been made of one of them. This was accomplished by noting small scratch marks made by a key duplicating machine. These scratch marks ran lengthwise on the notched surface of the key. No such marks appeared on the other two keys. The possessor of the key, a stenographer, confessed that she had loaned it to a boy friend. He was later tried and convicted.

4. Hundreds of dollars worth of cigarettes were taken from various cigarette machines through the use of slugs. Under questionable circumstances, a man was seen placing a coin in a machine. He was arrested, and when the machine was opened it was found that the last coin inserted was a slug. The home of the suspect was searched and a mold was found which was definitely proved to have been the mold in which that slug was made. Various irregularities on the surface of the slug were the identifying characteristics in this case.

5. A small wooden box was a vital piece of evidence in a hold up. Two suspects were arrested and another box was found in the home of one of these men. Both boxes were made of the same type of plywood. The boxes were proved to have had a common origin (1) by matching the grain of two of the boards, (2) by comparing the planer marks on a number of the other pieces of wood, and (3) by identifying the tacks used in both boxes as having been made by the same stamp machine.

6. A car was loaded with loot from a burglarized store. As it pulled away the muffler, because of the increased load, scraped across the surface of a rock imbedded in the road. Later it was possible to duplicate these scratch marks on the muffler by dragging a similar object over the surface of the rock; this evidence aided in conviction.

7. A fire broke out in the attic of a house on which the owner had recently obtained considerable insurance. After the fire had been extinguished a fireman found a number of cans filled with kerosene; these had been placed at strategic points throughout the attic. The owner of the house denied ownership of the cans, and stated definitely that they had not come from his home. The cans were proved to have been opened by a can opener from his

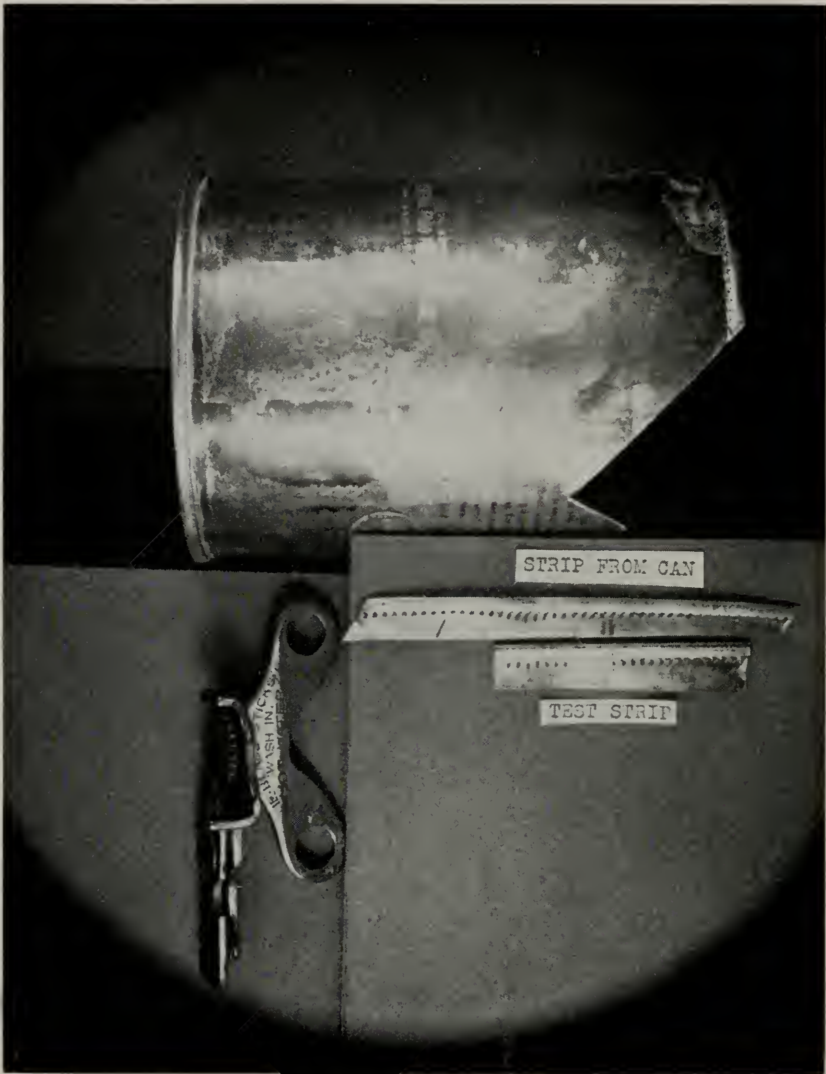


Figure 1. Arson case: can filled with kerosene came from attic of suspected arsonist. Can-opener was found in his kitchen; upper strip came from can in the attic; lower strip came from can opened by can-opener.

kitchen. This was accomplished through an identification of the teeth marks of the ratchet portion of the opener.

8. A man set fire to the home of his estranged wife, and, to prevent her from contacting the fire department, cut the tele-

phone wire in the basement. The wire was proved to have been cut by a pair of side cutters found in his possession.

9. In an attempted homicide, the detonator wire used in the manufacture of a bomb and a piece of detonator wire found in the workshop of the suspect were proved to have been made by the same machine. This was done through comparing characteristic striations on the outside of the wire.

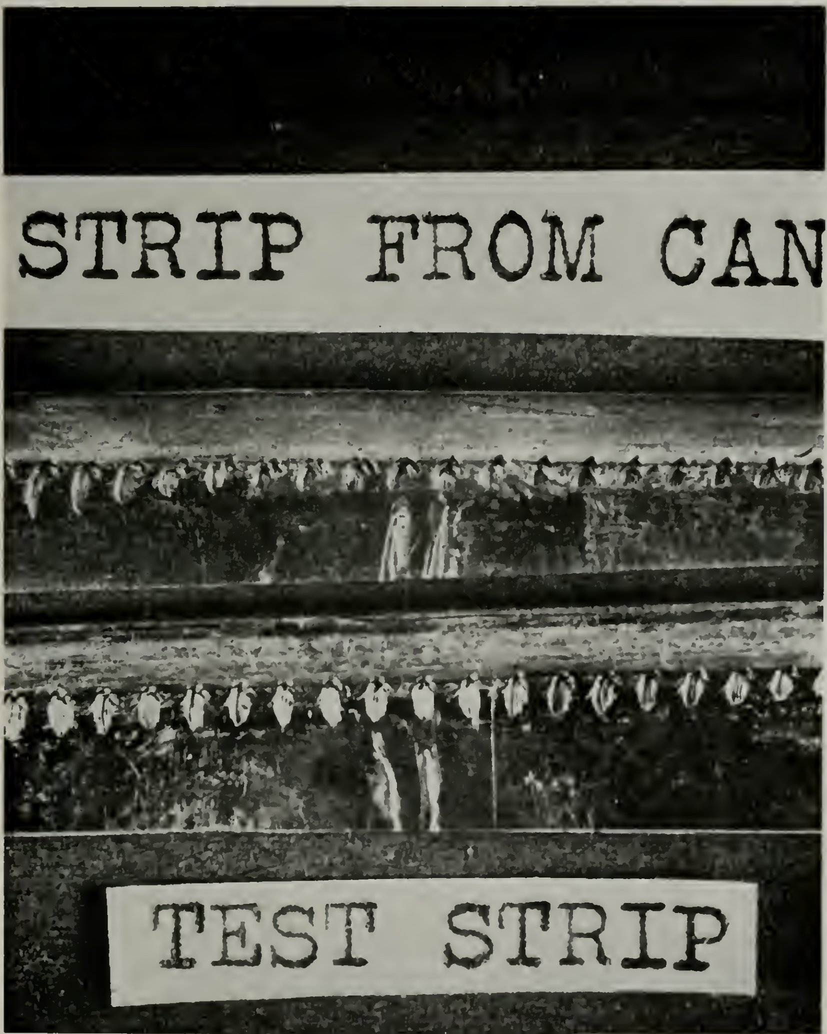
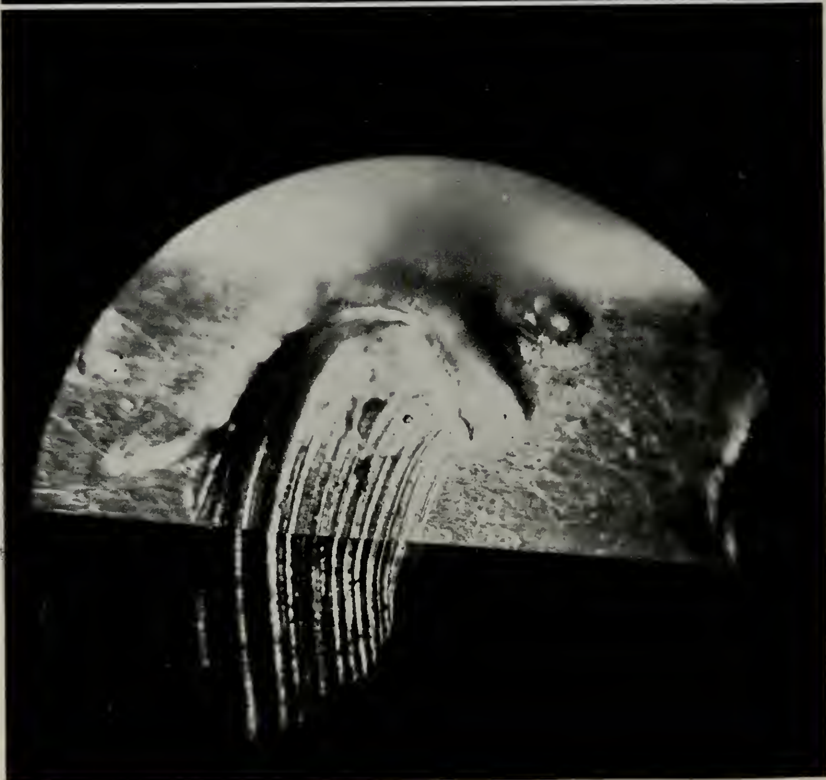


Figure 2. Enlarged photograph of a strip from can in the attic and test strip made by can-opener found in kitchen.



10. In many cases involving stolen car radios, it has been possible to prove that a specific radio came from a certain car by proving that the piece of wire attached to the radio and the part remaining in the car were cut by the same instrument.

11. In a safe burglary some sacks had been wired around the safe to deaden the sound when it was blown open. The wire holding the sacks together was proved to have been cut by the same instrument as was used to sever a piece of wire found in the suspect's tool kit. The instrument was never recovered.

12. In a theft case, even though it proved impossible to identify the hacksaw which had severed two pieces of metal, it was possible to prove that the two pieces at one time had been one and

Figure 5. Arson case: side cutters used to cut telephone wire to prevent occupant of the house calling for help; end of telephone wire and a piece of lead cut by side cutters for comparison.

←

Figure 3. Comparison of striations: top half photograph from can in attic, bottom half made by can-opener from kitchen.

Figure 4. Comparison of striations made by another ratchet tooth of the can-opener.

the same by comparing scratch marks running lengthwise on the metal—flaws which had had their origins previous to the severance.

13. In a hit-and-run case one car struck another with a glancing blow, upsetting it and killing the driver. The first car was proved to have been the one involved by identifying a mark left in the running board of the victim's car as having been made by a bolt in the bumper of the defendant's car.

The basic principle in tool mark comparison is the reproduction of similar marks with the suspected tool or instrument, simulating as nearly as possible the conditions under which the original marks were made. If the imprint or scratch striations are in copper or brass, then that type of metal should be used to make the exemplar. Where the marks are in iron or steel, it is not feasible to use metal of such hardness. Either lead or zinc is more satisfactory, as they are softer and have the same approximate color, thus will photograph similarly. At times it may be found advantageous to use wax or "woods metal," at least in preliminary examinations.

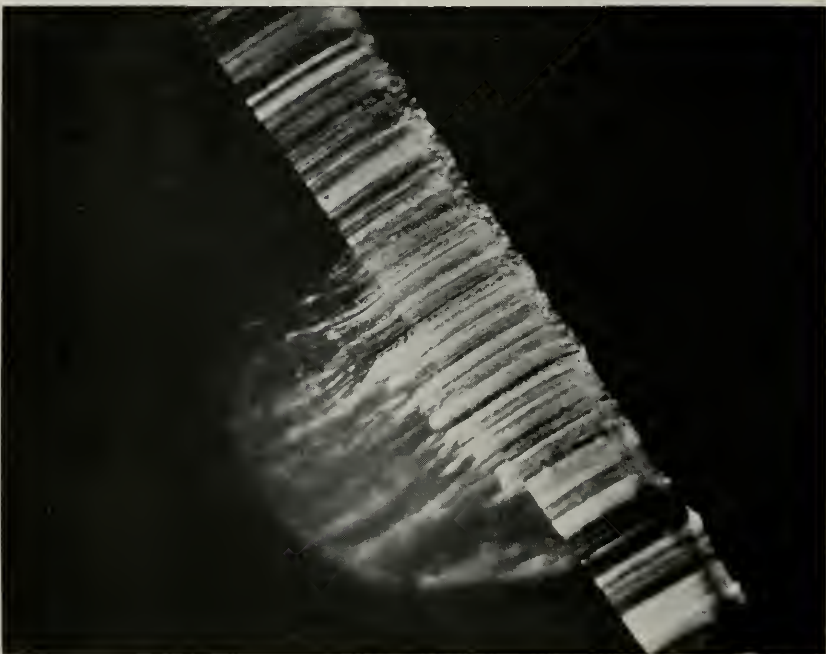


Figure 6. Comparison of the test lead strip and end of telephone wire, part of telephone wire is out of focus, but striations definitely matched.

Figure 7. Top: the end portion of a coat hanger wire found in a burglary suspect's car; the botton portion of the photo shows end of coat hanger wire that had been found holding sacks around a safe that had been blown open with nitro glycerine.

It is always well to make photomicrographs wherever possible, as they will illustrate to a jury, to some extent, what the expert was able to see through the microscope. It should be emphasized

at the time such evidence is presented to the court that the photomicrographs are introduced only to illustrate a portion of the information gathered through microscopic study, and that the expert opinion is not based upon the photographs, but rather upon what was seen during the study and comparison made through the microscope. The reason this dissertation is necessary may be clearly illustrated by citing bullet comparisons. An expert may arrive at the conclusion that two bullets have been fired by the same gun only after he has studied and compared each land and groove on those bullets, and it would be possible for him to glean information after such a study that would be difficult to photograph in its entirety. A photograph has only two dimensions, whereas a stereoscopic microscope has three. Also his opinion may be based not only on what he saw through the microscope but upon other sources of information, such as chemical tests, et cetera, which may be impossible to photograph.

Wherever possible, tool mark comparison should be made through the use of a comparison microscope. With this instrument it is easier to obtain accurate lighting, as the amount of light falling on each object can be varied, thus when photomicrographs are made the similarity is more clearly defined.

If the exemplar and questioned tool mark are both in brass or bronze, or if the exemplar is in lead and the questioned tool mark is in steel, photomicrographs of such comparison will have a similar density. In other words, they will look alike. Again, the author wishes to emphasize that when presenting comparisons in courts of law, the more nearly the two objects resemble each other, the easier it is for the jury to understand the evidence presented.

Sometimes tool marks are found on such large objects as the door of a safe or a window sill, and it may be necessary to cut out that portion on which the tool marks appear to enable one to make an indentifiable comparison. The owner may be reluctant to permit such a procedure, but even though it be necessary for the law enforcement agency to replace a door or window sill, it is well worth the cost if, through tool mark comparison, it becomes possible to convict the perpetrator. However, before the piece is cut out a photograph of the entire object should be taken, showing the relative position of such a mark on that object.

Making Exemplars

Before making exemplars the suspected tool or instrument should be studied carefully under a wide field binocular stereoscopic microscope. Often pieces of paint or some other type of debris of evidential value may be found adhering to it, which, of course, should be removed before any exemplars are made, as they would probably be lost in the operation.

Since it has been pointed out that many types of tools or instruments can leave tool marks on various objects, it might be well to discuss methods for making exemplars with these different tools.

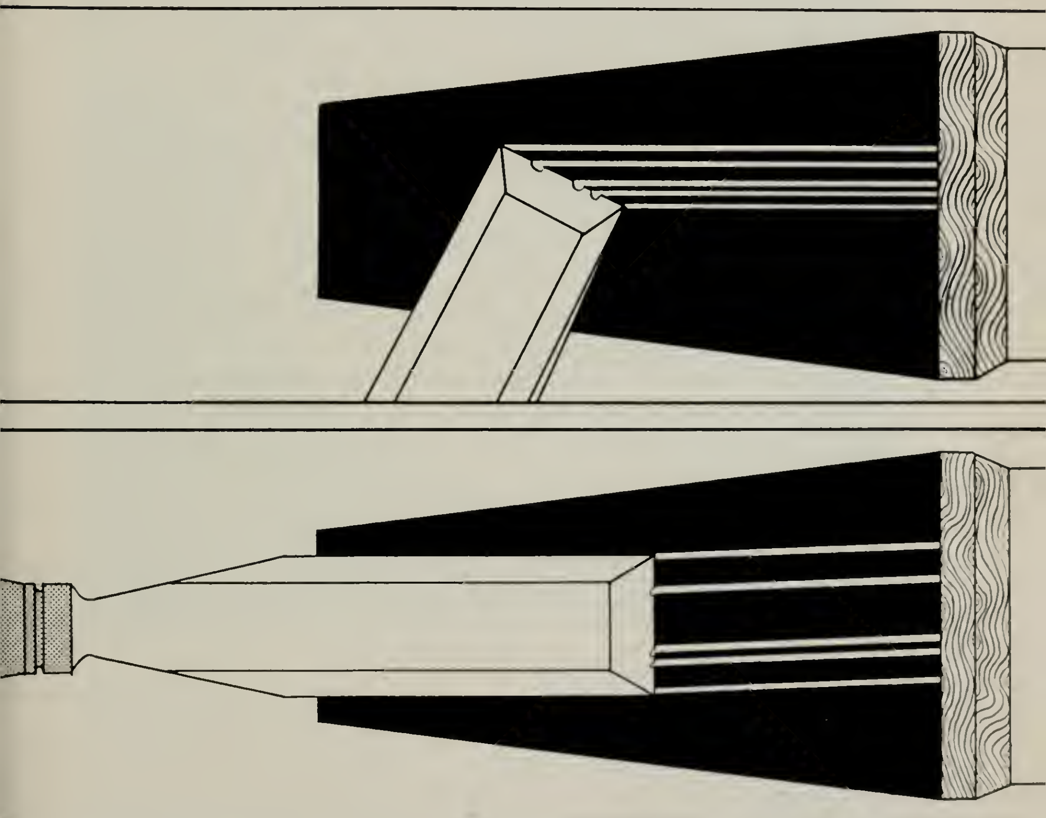


Figure 8. The mark left by a tool is dependent upon the position of that tool when it comes in contact with a softer surface. The above shows a difference in the width of pattern when tool is canted.

An exemplar of the cutting edge of a pair of side cutters may be made by cutting a piece of strap lead, brass, or copper the same width as the cutting edge of the instrument.

Exemplars may be made with screw drivers, pinch bars, et cetera, by drawing the instrument across a softer medium, producing the widest mark possible. If this mark is not similar to the one with which it is being compared, it may be necessary to cant the handle of the screwdriver or bar to one side, or to emphasize one portion of it more than the other, in order to simulate the questioned mark. It is also true that as the angle between the instrument and the surface varies, the distance between the striations will also vary. To explain more clearly, a screwdriver held perpendicular to the surface of a window sill, then moved across the painted surface, will leave striations characteristic of the end of the screwdriver; but if the same screwdriver were inclined at a 45° angle and then drawn along the surface of the paint, a completely different set of striations would probably result.

Where a hammer has left a mark on a safe (or on any painted object), a key to that portion of the hammer which came in contact with the object may be found through a microscopic examination of the tool. Small particles of paint, bronze, or other material may be found adhering to one of its edges.

To reproduce the striations made by the cutting edge of a bit, a soft type of wood, such as sugar pine, makes an ideal medium for the exemplar. Pieces of wood may be obtained which are impregnated with resin or pitch. These are excellent for this purpose. When the striations are in paint, other portions of the same painted surface may be used for exemplars. It will be found that the best striations (of this type) in paint are made at the instant the bit enters the painted surface. Thus in searching for bit cuttings at the scene of a crime, those found having paint on them should be saved for later comparison. Excellent reproductions of the cutting edge of a bit may also be found if the bit has entered roofing paper on top of a building.

A pocket knife leaves identifiable striations only if the knife passes straight through the object. Its marks would be of no value if a sawing effect were used.

Figure 9. Bit found in a burglary suspect's automobile.

Comparing Torn or Broken Objects—Contour Comparison

This procedure is closely allied with tool mark comparison. It is the process of fitting two objects together mechanically, thus proving through a contour pattern that they once were one and the same. It might be well to enumerate a number of cases in which such evidence has been of infinite value in obtaining convictions:

1. A man gained entrance to a garage, and in so doing tore a small piece of skin, about a quarter of an inch long, from the inside of his thumb. This piece of skin was rolled up and dis-

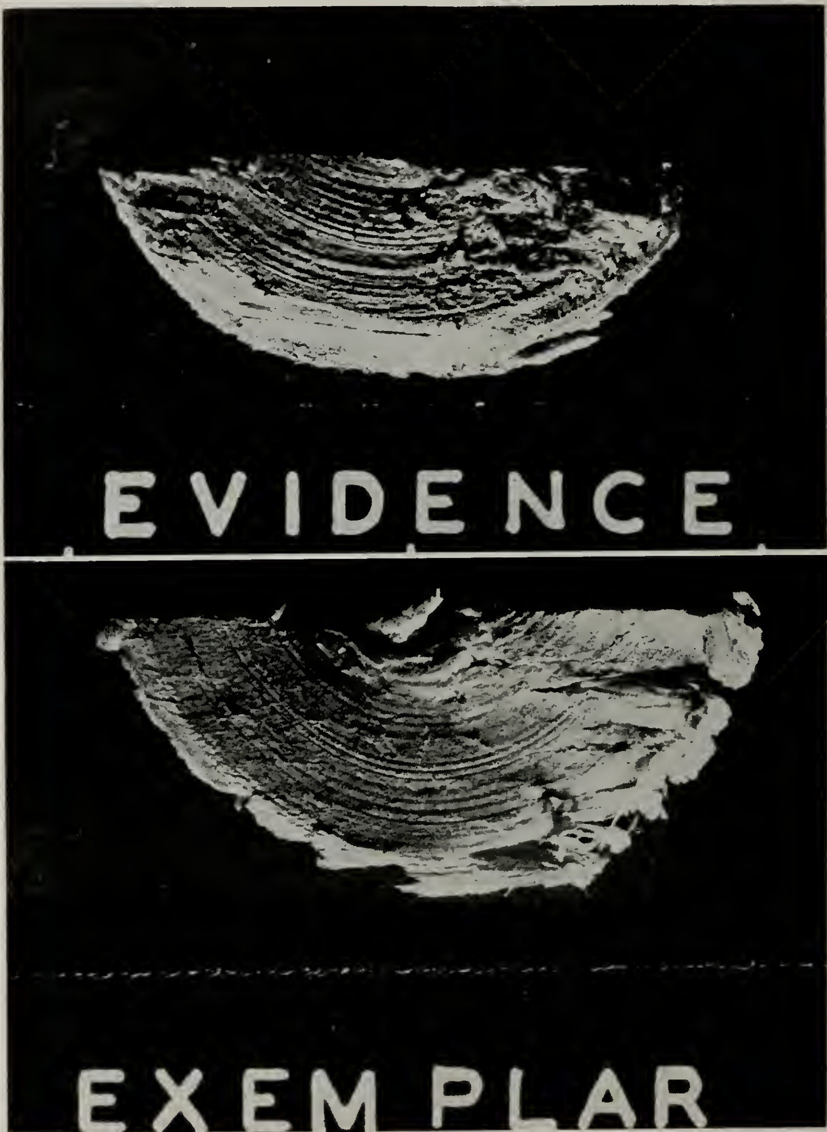
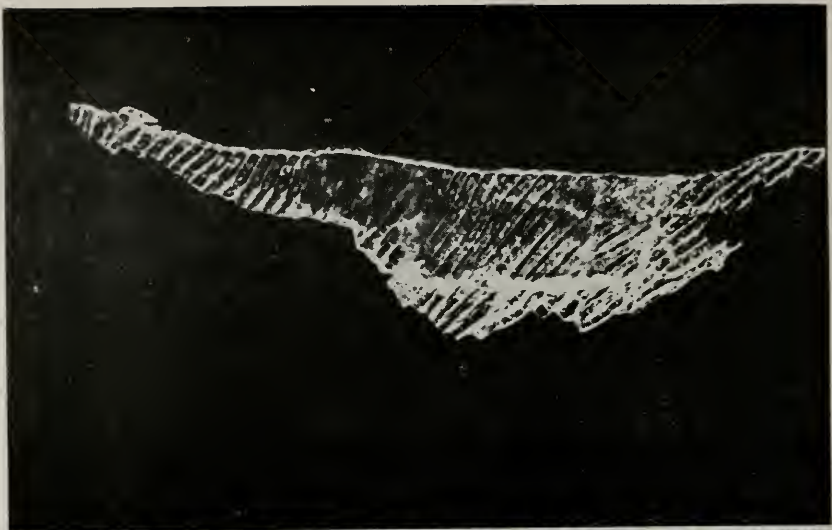


Figure 10. Top: shaving made by use of braces and bit found at entrance of a burglarized store. Bottom: photograph of shaving made by bit in illustration 9.

carded on the running board of an automobile in the garage. He succeeded in stealing another car and was later apprehended alone in the stolen auto, but he was seated on the passenger's side. The car was parked at the curb. He denied knowledge of the theft and claimed that he had been given a ride by the driver of the car. This was during World War II, and, as he was wearing a Navy uniform, credence would have been given to his story had not the officers noticed a place on his thumb where a piece of skin was missing. The wound in the thumb was photographed, as was the piece of skin found in the garage, and, after super-imposing one photograph over the other, they were found to match. Actually in this case there were three distinct points of comparison. (1) The contour of the piece of skin matched the contour of the wound; (2) the ridge formation on the thumb corresponded to the ridges on the piece of skin; (3) continuous indentations caused by wrinkles on the thumb could be traced from one side of the thumb, across the piece of skin to the other side. The man was convicted on this evidence.

2. Two pieces of adhesive tape were instrumental in convicting a "petting party" bandit who preyed upon couples he found

Figure 11. Comparison of evidence shaving and exemplar shaving from Illustration 10.



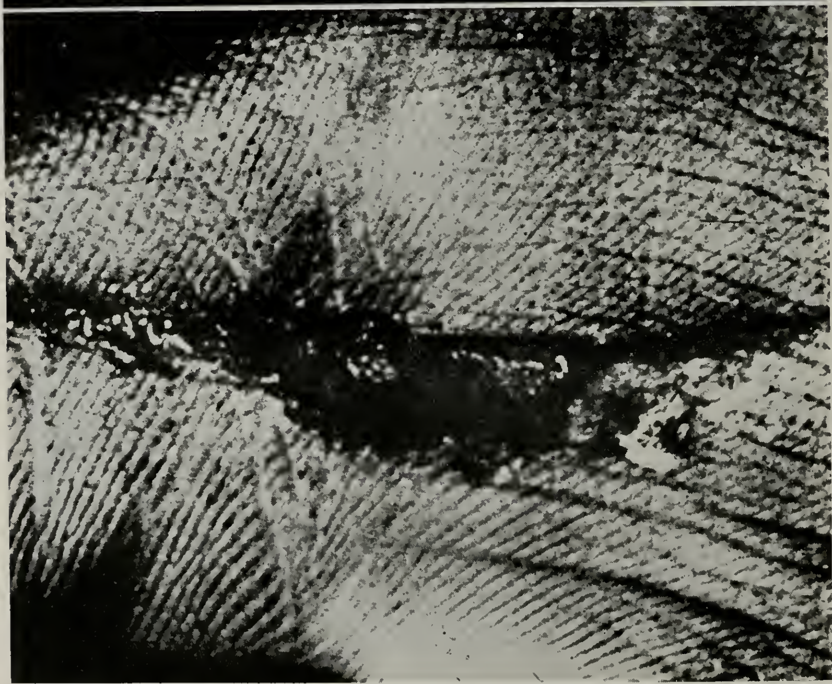


Figure 12. A small piece of skin showing friction ridges was found on the running board of a car in a burglarized garage. The suspect tried to start car, but was unsuccessful. He did succeed in taking another automobile.

Figure 13. A wound on the inside of thumb, left hand of a suspect; suspect

parked in canyons and in other out-of-the-way places. This man had accosted numerous petting parties over a period of many months, robbing the men and raping the women. His victims were unable to identify him, as he spoke little and operated only on the darkest of nights. His procedure was to bind the wrists of the men, using adhesive tape for the purpose. He was captured leaving one of the canyons, and in his possession was found a roll of adhesive tape. The end of this roll of tape was compared with the tape used on his last victim, and it was possible to prove that the tape on the victim was the last piece torn from the roll found in his car. This was accomplished not only through a comparison of the contour pattern of the ends of the tape, but also through a comparison of the size of each thread. It was found that each thread matched in size throughout the entire cross sections of the

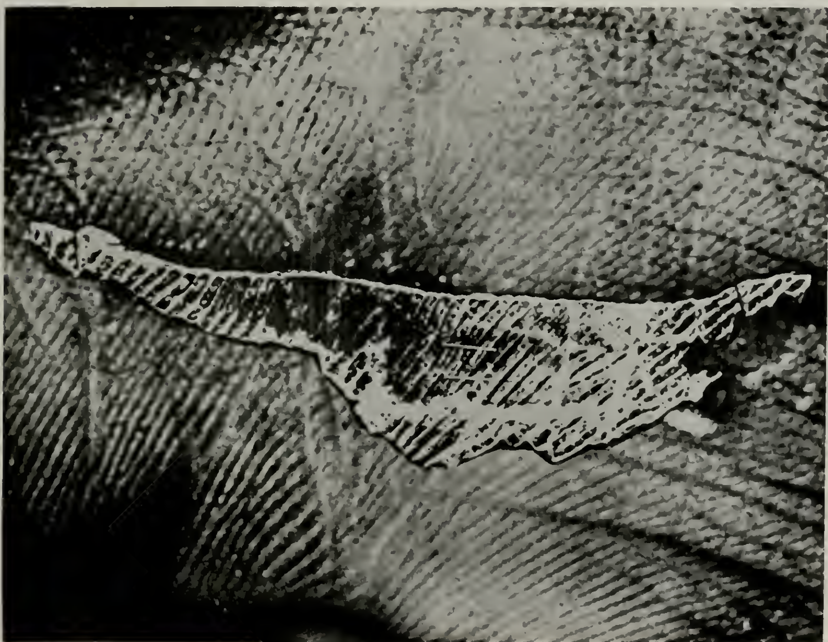


Figure 14. Comparison of piece of skin found in garage and the wound on the hand of suspect. (see Illustration 12).

←

was found sitting inside of the stolen car on the passenger side. Car was the one stolen from the aforementioned garage. He was wearing a Navy uniform and denied having stolen car. He stated he had been given a ride by another party.

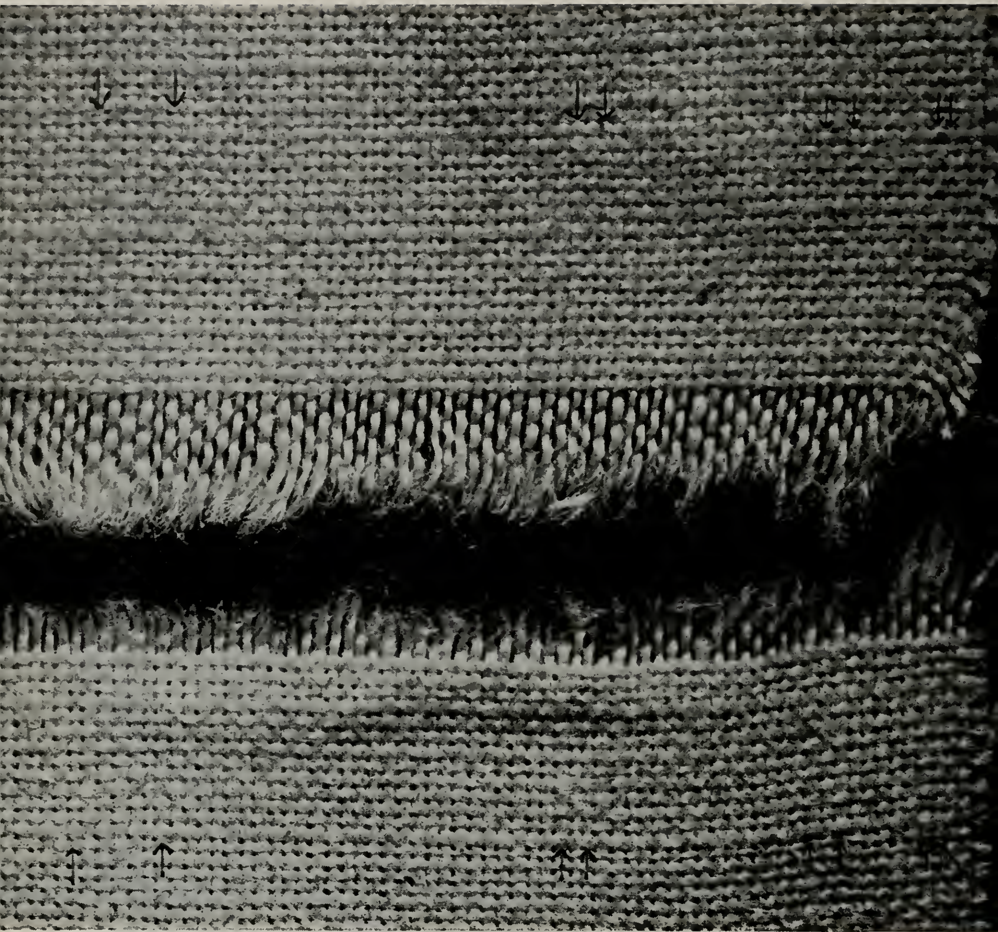


Figure 15. Top portion: end of roll of 1" medical adhesive tape found in a rape suspect's car. Bottom portion: piece of tape used to bind a victim's wrist; ends of tape were matched by noting the size and comparing each individual thread.

two ends. The size of a thread in a piece of adhesive tape is not uniform, but is dependent upon the amount of cotton which happens to be woven into that individual thread at that particular spot.

3. In a burglary during which a number of bolts of cloth were stolen, a comparison similar to the preceding illustration was made. A small sample had been cut from one of the bolts prior to the burglary, and it was possible to match the line of severance

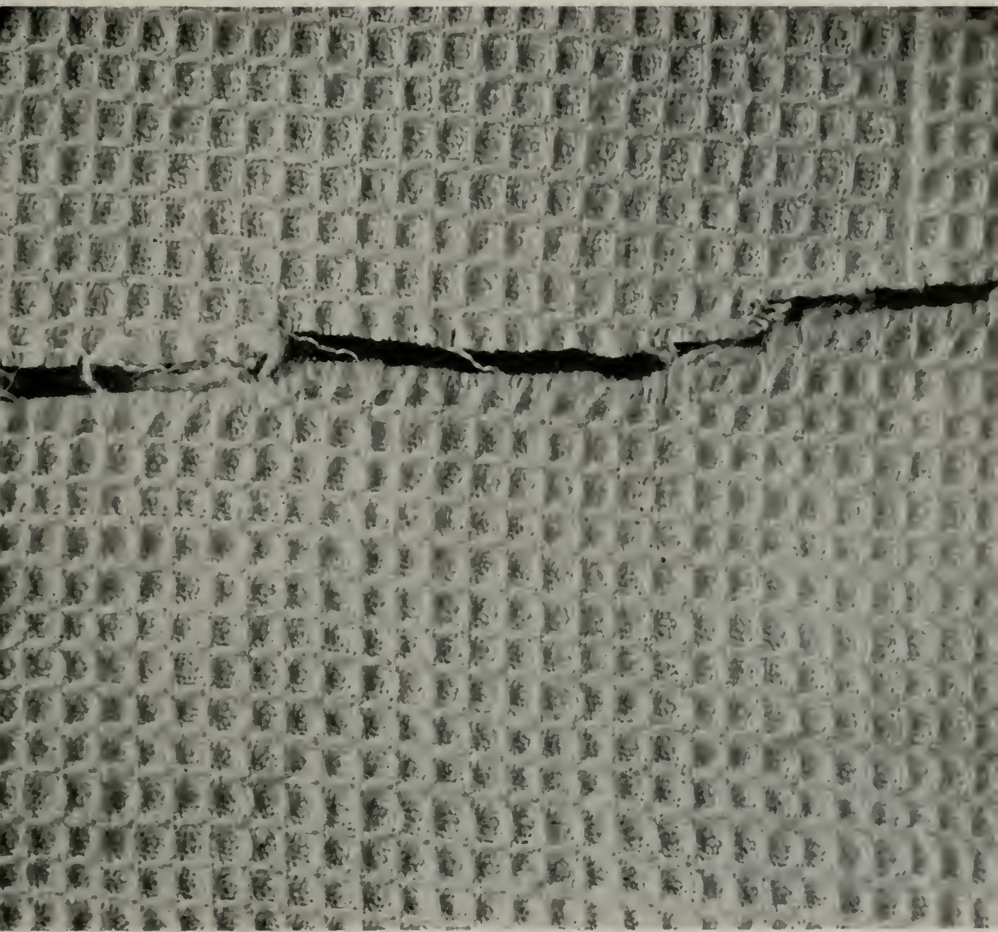


Figure 16. Top portion: piece of towel used to gag a kidnap victim. Bottom portion: remaining part of towel found in suspect's home.

between it and the bolt of cloth found in the possession of the suspects. Again the threads matched in size.

4. Three boys were arrested. One of them had in his possession several marihuana cigarettes rolled up in brown wrapping paper. The other two boys denied any knowledge of the narcotics, but a search of the wastepaper basket in their room brought to light a piece of paper which was proved to have been cut from the paper wrapped around the cigarettes. All three were convicted.

5. Two boys were arrested in a stolen car in which was found five or six hundred dollars worth of cigars, tobacco, cigarettes, and

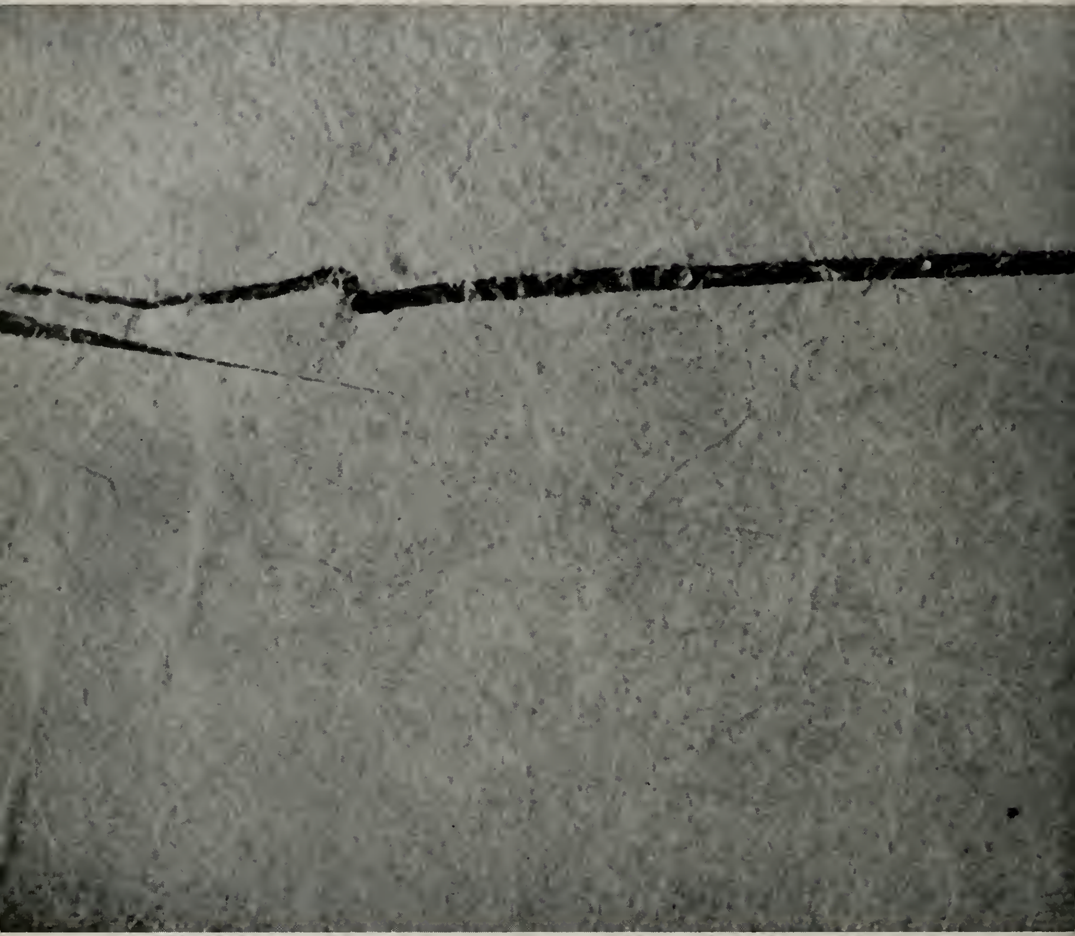


Figure 17. Top portion: piece of paper found wrapped around six marihuana cigarettes. Bottom portion: piece of paper found in waste paper basket at home of accomplice.

candy. They denied that the merchandise had been stolen. Through matching the contour pattern, a box top found at a burglarized store was proved to have been the top from a carton of cigarettes found in their possession.

6. Numerous hit and run cars have been proved to be the vehicles involved through comparison of broken ornaments, bumper guards, et cetera.

7. Broken headlight glass has also played an important part in many hit and run cases. The various methods of identification

Figure 18. Small piece of wood marked "C" found in turtle back of burglar suspect's car; piece marked "S" part of a broken box found in a safe that had been stolen, emptied, and dumped in a field; comparison indicates that safe was hauled in car.

pertaining to hit and run are covered at greater length in the chapter on Hit and Run.

8. An Elk's Lodge was burglarized and the safe carried away. Two suspects confessed and implicated a third as having been the one who hauled the safe in the turtleback of his car. He denied the allegation, but a small piece of wood about one-half inch long, found in the turtle back of the car, matched, with a contour pattern, a piece of a broken box which had been found in the re-

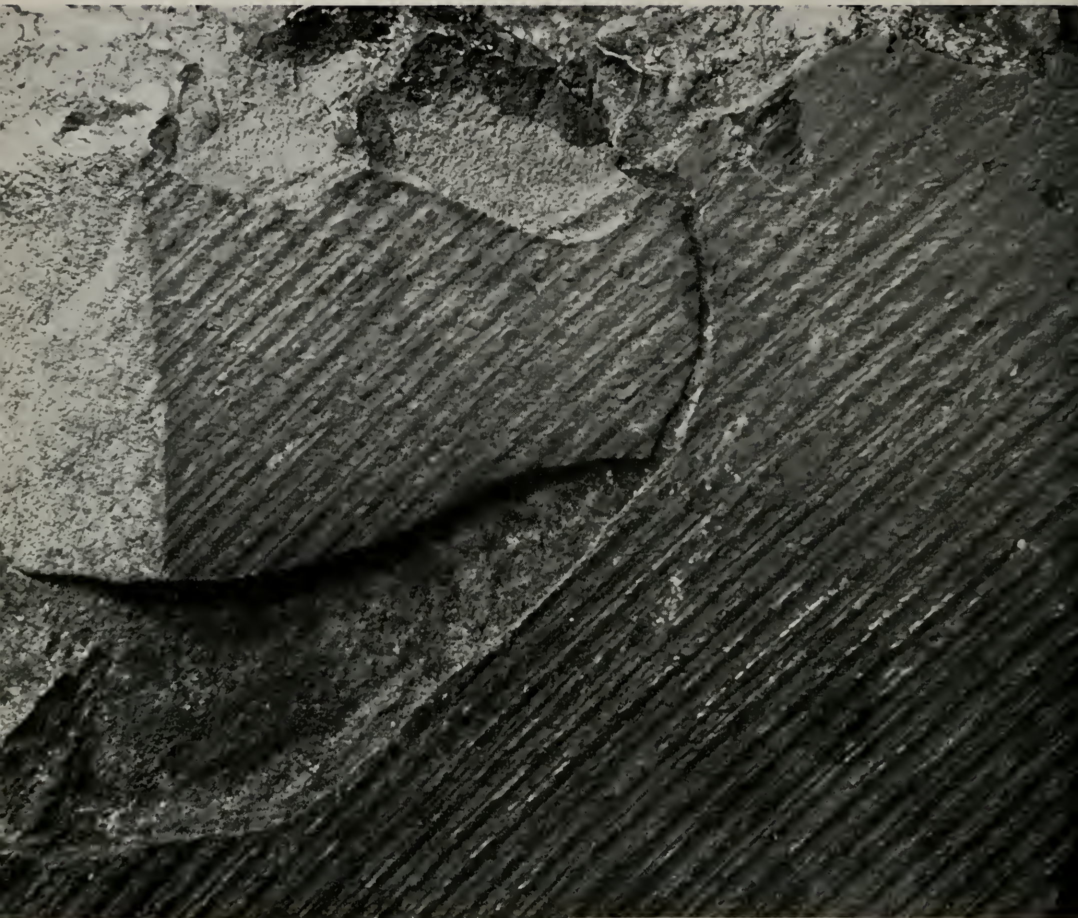


Figure 19. Woolworth Store was burglarized and safe carried away; safe was later located in a field and debris from a suspect's garage was brought to the laboratory along with the safe. Illustrations 19 and 20 show pieces of metal that fit mechanically to safe. Metal came from debris in garage.

covered safe. This was instrumental in convicting all three suspects.

9. A Woolworth store was burglarized and the safe carried away. Two men were under suspicion and a stakeout was placed on their home. They were seen to leave and enter numerous times, but at no time did they carry anything similar to a safe. About four days later the safe was located on a vacant lot in another section of the city. The two suspects were arrested, their

Figure 20. Matching of safe and broken piece of metal in Woolworth's Store burglary; through this evidence nine suspects were arrested and seventy-three burglaries cleared.

garage was swept, and the debris brought to the Laboratory. In the debris were two pieces of metal (about the size of a little-finger nail), which were proved to have been chipped from the safe. This evidence was instrumental in getting a confession from the two suspects. They in turn implicated seven others, and the Los Angeles Police Department was able to clear up seventy-three burglaries in the cities between San Diego and Santa Barbara.

10. A ninety-two year old woman was murdered and all evidence pointed toward the daughter-in-law as being the one who

had committed the crime. The victim had been seen alive at eleven-thirty in the morning. The daughter-in-law called the Police Department at twelve-ten and stated that her mother-in-law had been beaten to death. She stated that the victim was in her bedroom and that her wrists were tied with an undershirt. Although some of the dresser drawers had been pulled out, apparently nothing was missing. The daughter-in-law could not account for her time. She was arrested and her clothes were examined in the laboratory. No spurts of blood were found, which should have been present had she committed the offense. Three pieces of physical evidence were found to be foreign to the scene: (1) a small piece of plastic, about one-fourth of an inch long, that appeared to have been broken from some type of a handle; (2) a button, found lying in the middle of the floor; (3) a blond hair, found in the knot around the victim's wrist. (The people in this household all had jet black or grey hair.) The daughter-in-law was released, and further investigation in the neighborhood disclosed that a blond boy, about twenty years of age, had been selling magazine subscriptions and had been seen within a few doors of the victim's home at eleven-fifteen that morning. For a period of three months the officers trailed this suspect from one market to another where he worked under a different name in each case. They finally located the place where he lived and paid a visit to his room, but he had moved out during the night. A fourth piece of evidence was found at this location—a small metal disc from a defense plant in Philadelphia. The disc was photographed on both sides and the photographs sent to this company. They identified the suspect and sent the Police Department his correct name, photograph, and fingerprints. A "want" was put out for him, and he was arrested in Douglas, Arizona. When his luggage was searched a gun grip was found which matched the small piece of plastic previously found near the body of the victim. The boy confessed and was given life imprisonment.

Again as a reminder to the investigator: save things that are out of place—a torn piece of paper, a broken button, part of a comb, a chip of plastic, a broken end of a drill or screwdriver—any one of these may aid in the proof of the case. In searching a suspect the same diligence is necessary. *Every article* in his possession should be saved, no matter how worthless it may appear at the time. Two bolts from the pocket of a murderer were dis-

Figure 21. Small piece of plastic found in the bathroom floor approximately fifteen feet from a murdered victim, a ninety-two year old woman. The victim had been severely beaten. Two months later a suspect was arrested and a pistol grip found in his suitcase matched mechanically with piece of plastic from bathroom.

carded as being of no value, yet it was later found that two bolts of the same size and shape had been removed from the horn of a car within a few feet of a murdered man. The discarded bolts were never recovered.

Comparative Analysis of Prints, Bites, et cetera

Many prints or impressions other than those made by shoes and automobile tires can have untold evidential value if they are noted by the investigator. Again, cases may be the best means of illustrating the value of this type of evidence:

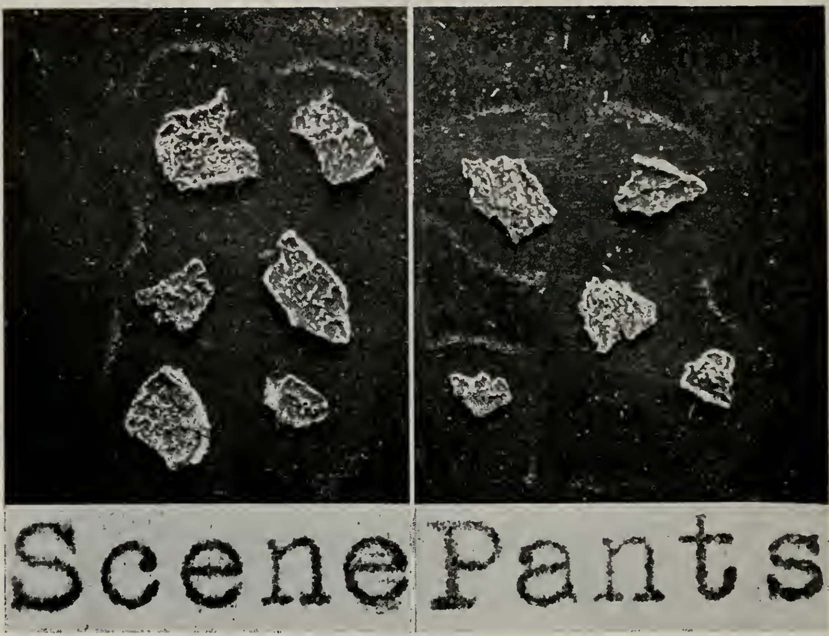


Figure 22. Paint found at scene of burglary and in trouser cuffs of suspect (one hundred seven burglaries were solved through this evidence).

1. A garage owner was suspected of receiving stolen property. It was believed that an automobile wheel in his possession had been removed from a certain automobile involved in a car stripping case. This was proved to be a fact by photographing the rust marks on the hub of the stripped car and comparing this rust pattern with that on the portion of the wheel which had been in contact with the hub. This enabled the officers to arrest the suspect, and although the case in itself was not too important, when the man was placed in a "show up" he was identified by seven different women as being the person who had raped them. The charge of receiving stolen property was forgotten, as he was convicted and sentenced to the state penitentiary for rape, but if it had not been for the original piece of physcial evidence he probably would never have been brought into a show up, as he supposedly was a substantial business man.

2. In a petty theft case with a prior, a spot-light in the possession of a suspect was proved to have been the one stolen from a certain automobile. This was accomplished through photographing a mark on the car left by a rubber washer. Small particles of

the rubber had adhered to the car at the time the spotlight had been clamped in place. This pattern was compared with the washer itself and the identity was made through contour comparison.

3. Teeth imprints on the breast of a victim in a murder case were shown to be similar to the teeth of the suspect, in that the tooth spacing was the same, and also by the fact that one tooth was missing.

4. In another teeth imprint case, impressions made by the suspect were shown to be similar to the teeth marks left on the cheek of a murdered girl. In each of these cases a comparison was made by taking a cast of the teeth of the suspect, then recasting sets of teeth similar to his. These sets of teeth were then pressed into flat plates of dental wax and the bites in the wax compared with photographs of the bites on the bodies. It is also a good procedure to have the suspect bite into a large piece of dental wax, then, after a cast has been made of both the upper and lower teeth, the wax can be removed by melting and a reproduction of the relationship of the upper and lower set can be illustrated to the jury. Thus if one tooth protrudes more than another and the

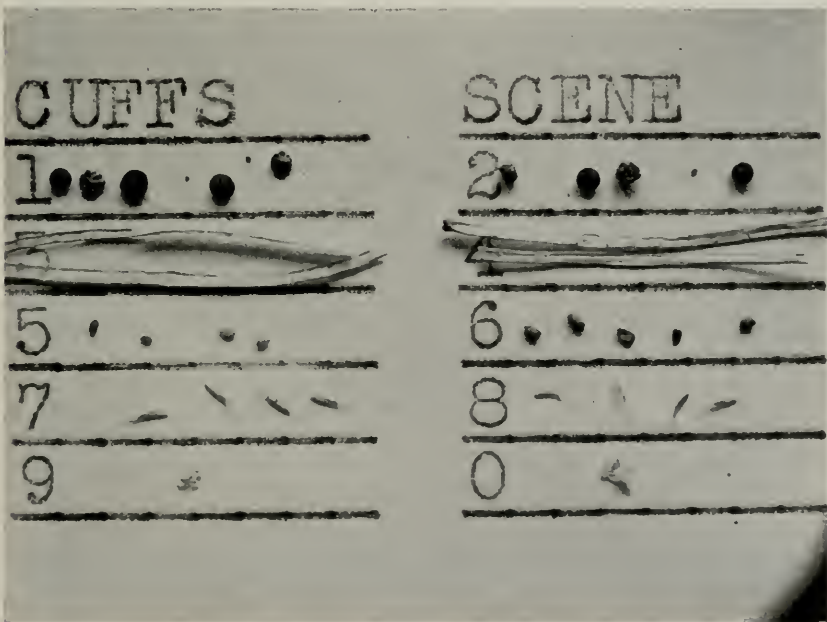


Figure 23. Seed pods and flower found at scene of murdered boy compared with debris from trouser cuffs of suspect. Suspect convicted and executed.

Figure 24. Burnt match found at scene of burglary, proven to have come from book of matches in pocket of suspect.

bite on the body of the victim shows that tooth to have penetrated to a great depth, this illustration will have evidential value.

All photographs should be made perpendicular to the print itself, because no true comparison can be made unless such has been done. Also, a ruler should be in the photograph to show size, and it is well to have some means of identification present.

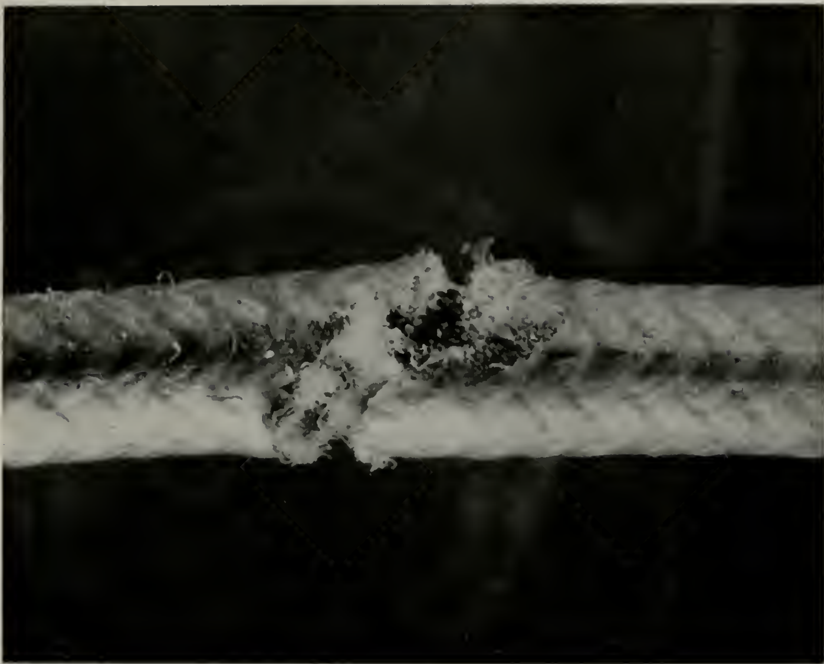


Figure 25. Right, piece of rope used as a garrot in a murder case; left, piece of rope found in possession of suspect.

Figure 26. Broken piece of pencil lead found on window sill of burglarized home, and a broken end of a lead pencil found in possession of suspect.

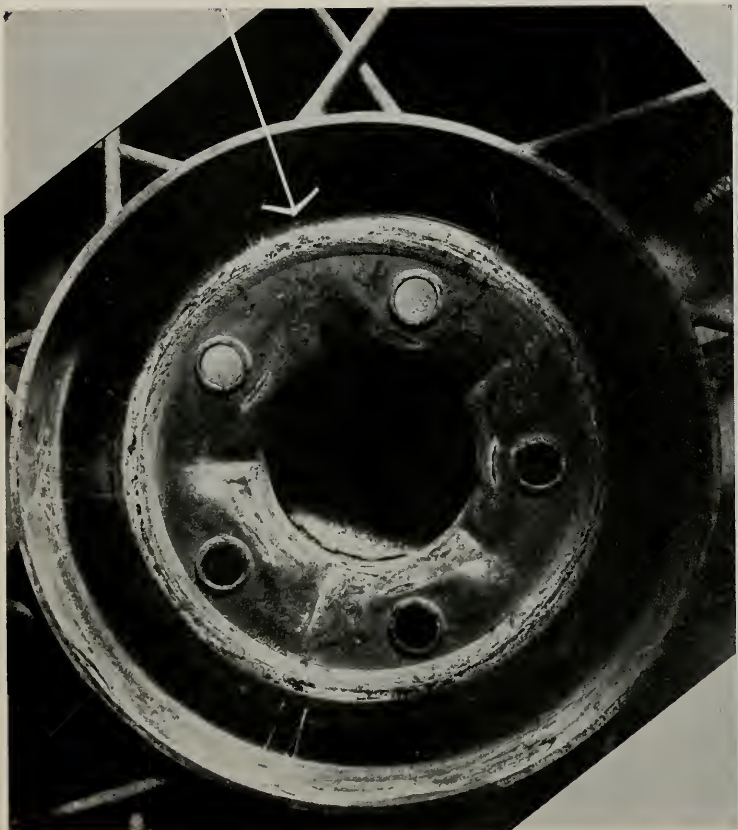


FIG. 28

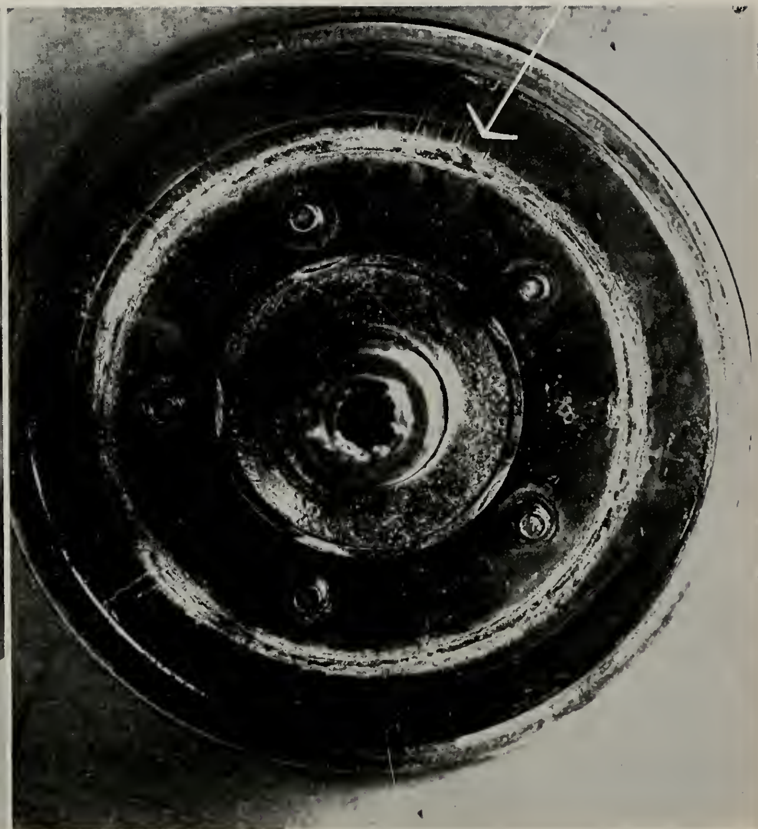
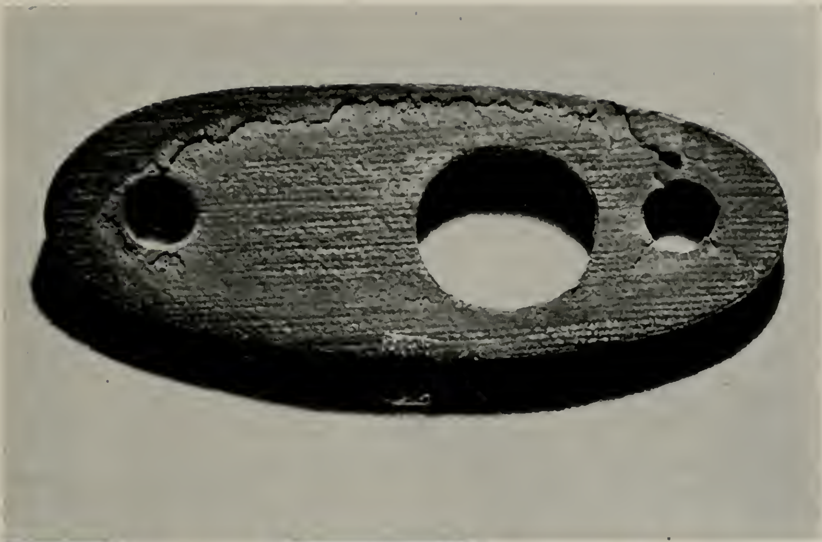


FIG. 27



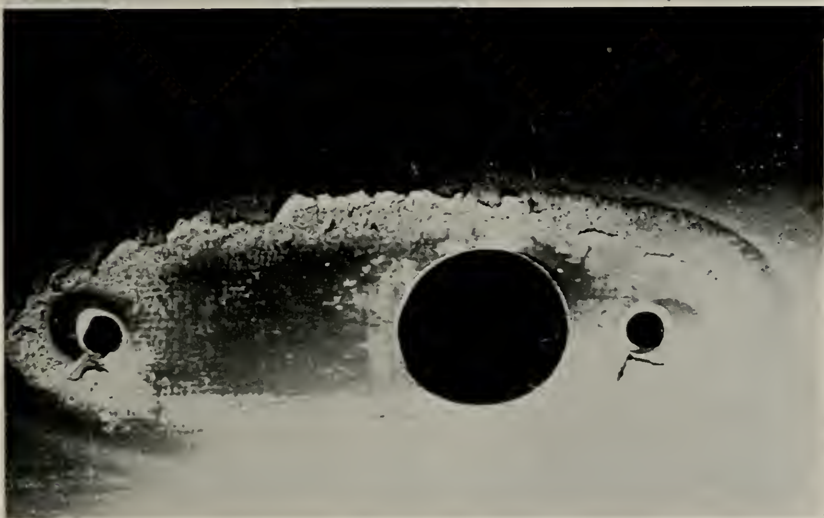


Figure 29. A rubber washer attached to a spotlight thought to have been stolen from a certain car.

Figure 30. A portion of rubber washer, Illustration 29, still adhering to the stripped car.

←

Figure 27. Hub of a stripped car, showing small rust marks in white circle.

Figure 28. Wheel suspected of having been stolen from car (Illustration 27) was proven to have come from that car by matching rust marks.

Comparison of Paint Layers, et cetera

Paint comparison has been found to be of great value in burglary convictions. Often burglars, in forcing entrance to an establishment, will pick up small pieces of paint from various parts of the building; these may be found in trouser cuffs, pockets, or adhering to clothing. Thus it is absolutely essential that the clothing be removed from a suspect as soon as it is possible to do so. The clothing should be handled carefully, marked for identification, wrapped in a large piece of clean wrapping paper, and then submitted to a laboratory for analysis.

In the laboratory the clothing should be laid out on the paper in which it was wrapped and the debris removed from all pockets and trouser cuffs, segregating and marking the debris from each source separately. After this is completed, the clothing should be gone over with the suction end of a tank type vacuum cleaner in which has been inserted, as a filter, a piece of gauze. Any additional debris adhering to the clothing can be gathered by this method.

The debris from the various sources can now be examined under the wide field stereoscopic binocular microscope, and paint, metal, metal turnings, small pieces of wood, et cetera, can be picked out carefully and may then be studied under higher magnification. The laboratory expert may find it necessary to visit the scene of the burglary in order to locate objects similar to the ones found in the debris.

When pieces of paint consisting of many layers are found, and when they can be matched with paint from the scene, layer for layer, they become of infinite value as evidence, and each additional layer may increase that value factorially. For example: the evidential value of a piece of paint consisting of ten layers, each layer of a different color, through the application of the law of probabilities, would be ten factorial; in other words it would be possible to rearrange these ten layers equal to the product of ten times nine, times eight, times seven, times six, times five, times four, times three, times two, times one—three million, six hundred twenty-eight thousand, eight hundred (3,628,800) different possible patterns! Now if one additional layer of another color were added, it would increase the evidential value eleven times. We have not taken into consideration here the thickness of each indi-

vidual layer, which also is an important factor; when these thicknesses vary, they add greatly to the significance of the material as evidence. The factorial is not always the true value as some of the layers may be more common than others.

Paint, pieces of metal, et cetera, may be compared through the use of the spectrograph. No two batches of paint are the same, spectrographically, thus when a batch of paint is mixed specifically for a certain building and the samples are of sufficient size to spectrograph, this method can be very conclusive.

Case Histories:

1. Entrance was gained in a burglarly by cutting a hole through the back door with a sharp instrument. A boy was arrested in the vicinity, and had in his possession a large jack knife. Although it was impossible to prove by tool mark comparison that the knife was the instrument used, a small piece of paint was found adhering to the blade of the knife. This paint compared with the paint on the door of the house, layer for layer. The house had been painted eighteen different times. This was very conclusive evidence, as it would be difficult to find another house with such paint duplication.

2. There had been a great number of house burglaries in a certain section of Los Angeles, and the Modus Operandi file indicated them to be the work of a certain individual, an ex-convict, who was known to be in the city at the time. He was shaken down a number of times, but nothing was found on him which could be used to connect him with any of the jobs. The officers, upon investigating one of the burglaries, noticed that the paint on the window through which entrance was gained was quite weathered and was peeling badly. They immediately arrested the suspect and brought his clothing to the laboratory. It was possible to remove from the clothing almost half a teaspoonful of paint which matched the paint from the house as to layers and weathered condition. Other suits taken from his home were examined from which paint was removed corresponding to paint from three other jobs. When confronted with this evidence the man confessed, thus clearing up one hundred and seven house burglaries in the city.

III

HAIR AND FIBER IDENTIFICATION AND COMPARISON

Often a jury will give greater weight to the identification of hair or to hair comparison than this type of evidence merits. There is no doubt that hair comparison can be of great value in helping to prove that a person did or did not commit a certain crime, but when this is the sole evidence, it is rare indeed that it can be used for positive identification.

Ocassionally hair may have some outstanding characteristic as a result of disease, or because of the fact that it has been dyed in some specific way. In cases of this type it has exceptional value. For example, in a certain case hair had outstanding evidential value because of the fact that the victim's hair and hair found on the clothes of the defendant was a definite purple shade, caused by an error in dyeing. In another case some hair from a hit and run victim was found in the grillwork of the suspected car. This hair had peculiar characteristics in that the cuticle or the outer scalelike portion had been loosened through the use of a bleaching agent, and they actually stood out like the limbs on a tree.

The more hair found at the scene, the better the chances of comparison. If a small tuft of hair has been torn from the head of a victim, an examination of that hair will enable the expert to note the variations and the relationships of these variations to the hair of the victim's head. All hairs in a person's head are not exactly alike. They may vary considerably as to texture and as to their appearance under a microscope, yet there may be certain characteristics that are more or less common to each.

Preliminary Examination of Hair

Before hair samples are cleaned, cut, or mounted, they should be carefully examined under a medium powered microscope for adhering debris such as pollen, flour, sugar, brick-dust, or any

other identifiable substance. The length of each hair should be carefully measured and such measurement listed. The condition of the tip should be noted and it should be determined whether it was severed, or broken, and, if severed, the type of instrument used. Examination of the tip may disclose that it had been freshly cut with a pair of shears, indicated by a V-type tip. A razor leaves a slanting, diagonal cut across the shaft.

The color of the hair should be observed, also whether straight, wavy, or kinky. The bulb or root should be examined and its condition noted. If the hair was alive at the time it was removed, the bulb will be oval and plump in appearance. A dead root, as found on fallen hair, will be shrunken and withered.

Cleaning Hair

Grease and adhering debris may be removed from the surface of a hair by washing it in a fifty-fifty mixture of ether and alcohol.

Scale Pattern

A cast of the pattern of the scale, or cuticle, may be reproduced by pressing the hair into a thin layer of cellulose acetate on a glass microscope slide. Cellulose acetate dries quickly and when the hair is removed a perfect reproduction of the scale surface is left on the slide. This may be viewed through a microscope, using oblique lighting. Any cellulose acetate remaining on the hair may be removed by washing it in acetone.

Mounting Hair

In order to study the interior structure of a hair it must be mounted in a longitudinal plane and viewed under magnification of about 150 diameters, using transmitted light as a light source, in other words, permitting the light to pass through the hair. The following has been found to be a satisfactory method for mounting hair. Cut the hair into one inch segments beginning at the bulb end, and align each segment side by side in sequence on a microscope slide. Allow a drop of some mounting medium, such as gum demar or balsam gum, to fall in the center of the pattern, then cover with a cover slip. Permit the mounting medium to spread by the weight of the slip. The slide may then be placed

under a microscope for study. Gum demar and balsam gum are resinous materials, and either is satisfactory for use in mounting hair or fibers. To prepare a gum for mounting dissolve one of these resins in zylol until it has the consistency of maple syrup.

Microscopic Examination of Hair in a Longitudinal Plane

A hair viewed in the longitudinal plane may be divided into four parts:

1. *Medulla*—the dark, core-like portion, which may or may not be found in human but is always found in animal hair. This may be likened in appearance to the pith of a tree. In human hair the medulla may be found to be continuous, in segments, or totally absent, and all three of these conditions are sometimes present in the same head of hair.
2. *Cortex*—that portion between the medulla and the cuticle. In human hair this generally fills at least three-fourths of the total diameter of the shaft.
3. *Cuticle*—scale-like covering over the outer surface of the hair. On human hair, each scale overlaps the one beneath it approximately four-fifths of its surface. They may be likened in appearance to the shingles on a roof, or the scales on a fish. The cuticle will not be visible when the hair is mounted and viewed with transmitted light.
4. *Pigmentary granules*—small bodies of pigment found in the medulla and cortex, giving color to the hair. Also closely related to these are small vacuoles, or air pockets, having similar appearance to pigmentary granules and dispersed through the same regions.

Making Cross-Sections of Hair

Futher information as to the similarity of two samples of hair may be gained through viewing cross-sections of each. It is difficult to make a cross section when the sample consists of one or two hairs only. Six or eight hairs normally make a bundle of sufficient size for the purpose.

The following is a satisfactory procedure for making cross sections of hair:

1. Clean the hair thoroughly, using a 50-50 mixture of alcohol and ether. Allow to dry.

2. Cut the hair into one inch segments, bundle them together and tie at the center with a piece of thread.
3. Heat a mounting wax having a melting point of about 62° C. until it is in a liquid state. Allow the bundle of hair to steep in the molten wax for approximately fifteen minutes. This will insure that the surface of each hair is completely coated with the wax.
4. Fill a small metal form, one cubic inch in size, with the molten wax. Forms may be purchased for this purpose. Insert the bundle of hair perpendicular in this container, and hold it in place with toothpicks laid across the top. Allow the wax to solidify.
5. Remove the cube of wax containing the bundle of hair and place in a refrigerator overnight to make certain that the wax is completely solidified. This process may be speeded by placing the wax cube in a mixture of crushed ice and water for a two or three hour period.
6. Remove the cube from the ice water and clamp in a microtome so as to have the bundle of hair perpendicular to the blade. Set the microtome to cut slices of the wax cube from 10 to 15 microns thick. The exact setting may best be determined through experimentation.
7. Coat the surface of several microscope slides with a thin layer of albumen (fresh egg white may be used for this purpose). Have these slides ready before beginning the process of slicing the wax.
8. As the microtome removes the thin slices of wax, they will have a tendency to roll up. Carefully remove these rolls with a small spatula or scalpel and float them on the surface of a beaker of water at a temperature of approximately 40° c. The slices will unroll and may be placed on the previously prepared microscope slide by inserting the slide beneath them in the water and gently raising it to the surface. At least a dozen separate mountings should be made to insure a thorough cross sectional study.
9. Incubate the mounted slides in an oven at about 50 to 52° C. for approximately twelve hours. This process cooks the albumen, and as one end of the cross section of hair is in contact with this substance it has a tendency to grip it and hold it in place.

10. Cool the slides and then remove the wax by dipping gently into a solution of zylol. Zylol has no effect on albumen. Allow to dry.
11. Locate the cross sections of the adhering hair under a low powered microscope. Add a drop of gum demar and seal with a coverslip.
12. The slides may now be studied at high magnification (from 100 to 300 diameters), using transmitted light.

Transverse Examination of Hair

There are many different cross-sectional patterns of human hair when viewed in the transverse plane, even considerable variation at times in hairs from the same head, but a study will generally show a definite relationship. A cross section of straight hair is almost circular. The medulla, if present, is also round.

Cross sections of wavy hair are generally eliptical, and the greater the degree of curl the more elongated the elipse. Some wavy or curly hair may be triangular.

A cross section of kinky hair often is eliptical, with concave sides.

Again, cross-sectional study of hair is not conclusive. It is just one more point of similarity or dissimilarity in the process of comparison.

Cross-sectional study of hair from the author's own head disclosed twelve different patterns, although all were closely related as to shape, being different variations of a triangle.

Medullary Index

The medullary index may be used as a point of comparison, although, when standing alone it is not conclusive. It is the diameter of the medulla divided by total width of the hair and is designated by the capital letter "I." For example, if the medulla is found to be 0.007 mm in diameter and the hair has a diameter of 0.07, the medullary index is 0.007 over 0.07, or 0.1.

The medullary index of human hair is generally less than 0.3. Animal hair usually has a medullary index of 0.5 or greater. The medullary index may vary to some extent even in a single hair, thus to arrive at any definite conclusion many measurements must be taken and their averages compared.

Comparison of Animal and Human Hair

The expert can generally differentiate between animal and human hair, for they have many different characteristics. Below is a list of some of the outstanding differences:

Animal	*Human*
Value of "I" usually over 0.5	Value of "I" usually less than 0.3
Pigmentary granules appear as coarse grains	Pigmentary granules are in fine grains
Thick scales protruding not covering one another to such an extent as in human	Thin scales not protruding, each overlapping 4/5 of the one below it
Cells easily visible	Cells invisible without treatment
Fuzz has a medulla	Fuzz has no medulla
Air vacuoles appear as irregular grains	Air vacuoles are fine grains

Summary of Human Hair Comparison

Below is a summary of the steps to be taken in comparing two samples of human hair as to their similarity or dissimilarity:

1. Examine for adhering debris.
2. Compare the color at low magnification.
3. Measure and list the various lengths.
4. Note the character of the hair, whether wiry, stiff, silky, et cetera.
5. Examine the condition of the bulbs, if present, whether round and full or shrunken.
6. Note the condition of the tip, whether or not freshly cut; if so, type of instrument used, whether ragged or split, and degree of wear, et cetera.
7. Make casts of the scale or cuticle pattern as previously described.
8. Mount and view in the horizontal plane.
   a. Measure width at various locations.
   b. Find the average medullary index.
   c. Note the pigmentary granules and vacuoles, as to the size, color and number.
   d. Notice the condition of the medulla, whether continuous, broken, or absent.
   e. Examine the hair for the presence of dye; when hair

has been recently dyed, a small segment near the bulb may show a definite difference in color from the rest of the hair.

9. Prepare transverse sections and note the general characteristic shape.

If the above steps are carefully followed the expert may be able to say that the two samples of hair did not come from the same origin, or he may voice the opinion that they could have come from the same source, listing the reasons for his opinion.

Preservation of Hair

Hair found at the scene of a crime should be preserved in a glass vial if possible. If this is unobtainable, a cellophane envelope may be used. If neither of the above are available, the hair should be placed in a clean piece of paper and the paper folded as a bindle. This bindle may then be placed in an envelope and sealed for transporting. To place a hair loose in an envelope is very poor procedure. It is impossible for the expert to know the location of the hair at the time the envelope is opened. In the process of opening this type of container there is a definite possibility that one or more of the hairs may be cut in two, thus lessening their value as evidence.

Hair Growth After Death

The belief that hair continues to grow after death is fallacious. This is an impossibility. The hair is produced at the bulb or root, and for growth to continue these cells must receive nourishment. The supply of nourishment ends at the time of death. Blood is the medium through which food and oxygen are carried to the cells, and when it ceases to flow the supply ends.

Hair Turning Grey Overnight

That hair can turn grey overnight is also a fallacy. Again, such a phenomena is impossible. Hair is not a hollow tube through which liquid substances are able to pass. The color of hair is due to pigmentary granules which are in the cortex and medulla. Grey hair lacks this pigment. The pigment can only be removed by some strong bleaching agent, such as hydrogen peroxide, which is able to penetrate the cuticle and oxidize this

coloring matter. Hair may turn grey as fast as it is able to grow, and no faster.

Hair Found on Undercarriage of Car

Hair or fibers found adhering to the greasy undercarriage of an automobile have little evidential value unless there is something to indicate that a body has recently come in contact with that portion of the car. An automobile in the normal process of traveling on a highway may pick up many hairs, both animal and human, and as the identity of hair is not an exact science, such evidence is of little value.

Hairs of Different Animals

Deer Family:

1. The cortex is absent in hair from the deer family.
2. Medulla fills all the space inside the cuticle.
3. The medulla appears similar to flagstone—a pavement-like appearance. No other group has hair like this.

Bovine:

1. The hair from this species have transverse as well as longitudinal striae.
2. The wool hairs, or undercoating, may appear to be jointed.

Equine:

1. These also have transverse and longitudinal striae.
2. Hair of this species are scantily pigmented.
3. They have a dense, narrow pigmented medulla.

Rodents (*including mink, otter, muskrat, et cetera*):

1. Medulla fills most of the shaft.
2. The medullary cells appear to be fused together.
3. The margin of the medulla is serated in appearance.
4. All have transverse striae.
5. Hair of such animals as mink and muskrat have long, tapered tips.

Feline:

1. The medulla of the hair from the cat family generally fills more than half the shaft.

Canine:

1. The hair is similar in appearance to feline hair.

2. Considerable variation in the medullary index from various species of dogs have been noted.
3. Hair from the terrier often may be similar to hair from the silver fox, and careful study may be required to differentiate between the two.

Primates:

1. Hair is coarse, wiry, and is very similar to the human beard or mustache.
2. Hair is deeply pigmentated.

Fiber Classification

Animal Origin:

1. Wool — animal hair
   - a. Camel.
   - b. Alpaca.
   - c. Dromedary.
   - d. Vicuna.
   - e. Mohair.
   - f. Cashmere.
   - g. Felt.
2. Natural silks.

Vegetable Origin:

1. Wood fibers.
2. Flax — linen.
3. Rayon.
4. Cotton.
5. Artificial silks.
   - a. Viscose (cellulose thiocarbonate).
   - b. Cuprate silk (cellulose ammoniacal copper oxide).
   - c. Acetate silk (cellulose acetate).
   - d. Gelatine silks.
     - (1). Gelatine treated with formaldehyde.
     - (2). Made from milk.
6. Raine.
7. Jute.
8. Hemp.
9. Coir.

Mineral Origin:

1. Asbestos.

2. Spun glass.
3. Metal cloth.
4. Nylon.

Properties and Characteristics of Various Fibers

Wool Fibers:

1. There are three kinds of wool:
    a. The long or beard hair.
    b. The short hair or true wool.
    c. The long hair changing to wool.
2. Long hair is more prevalent in wild sheep and goats; it is not present to any great extent in domesticated sheep.
3. Cells of the wool contain oil (chiefly cholesterol).

Mohair:

1. Comes from the angora goat.
2. Is fine in texture.
3. Is used in the manufacture of clothing and upholstery.

Cashmere:

1. Is the wool from goats raised in Tibet and the Vale of Kashmir.
2. Is very fine and soft — is considered one of the finest wools.

Alpaca:

1. Comes from the vicuna and llama (camel family).
2. Alpaca beard hair is sometimes a yard in length.

Camel Hair:

1. There are two very distinct growths of hair on a camel:
    a. The beard hair used mostly in carpets.
    b. The wool hair used for manufacture of coats.

Real Silk:

1. Real silk comes from the cocoon which is spun around the larvae of the silkworm caterpillar. The silk is produced through the medium of four spinnerettes, two of the spinnerettes producing the fibers, and the other two producing a glue or cement-like substance which forms the two fibers into one strand. This strand is wound around and around the larvae until it is completely enclosed.
2. Silk is soluble in hot hydroxide and in both cold and

hot sulphuric acid, also in hot hydrochloric.

3. Microscopically, it has the appearance of a glass rod uneven in diameter. It does not have the typical striations that appear longitudinally on artificial silk.

Vegetable fibers are of two types:

1. Seed hairs or fibers attached to a seed. Example—cotton.
2. Bast hairs are fibers running longitudinally through the stalk of a plant. Example—sclerenchyma fibers of Indian Hemp.

Hemp:

1. Two common types are Indian Hemp and Manila Hemp. These are not from the same plant.
2. They are both bast fibers obtained through retting.
3. Microscopically, they appear to have longitudinal fissures.

Cotton:

1. These are seed fibers.
2. They may be mercerized through treatment with alkalies.
3. A cotton fiber under the microscope has the appearance of a twisted ribbon.
4. Microscopically, mercerized cotton has the appearance of having numerous small holes in the shaft. It appears to be perforated.

Artificial Silks:

1. These fibers swell in water.
2. Soap solutions and dilute acids do not affect these to any great extent.
3. They are easily destroyed by alkalies.
4. Wet fibers lose their tensile strength.
5. They are difficult to dye.
6. Tensile strength is about one-half that of natural silk.
7. Elasticity is about one-third that of natural silk.
8. They have the appearance under a microscope of a glass rod, with occasional uneven bulges. They also generally have longitudinal striae, which are marks made by the spinnerette during the process of manufacturing.

Linen:

1. Linen is very ancient in use on this continent, having been used by the American Indians.
2. It is made from the bast cells of the flax by retting. Retting is the process whereby a substance similar to flax is placed in a swamp or slough until the woody tissues decompose, leaving the cellulose fibers. There are also chemical methods for retting.
3. Linen fiber has the appearance under the microscope of a bamboo rod.

Jute:

1. The jute fibers are bast fibers.
2. These fibers come from a plant known as Jews Mallow.
3. They are grown principally in India.
4. Fibers are separated by retting.
5. They are used for coarse fabrics, such as gunny-sacks.
6. Microscopically, they have the appearance of half of a seed pod.
7. They also seem to have a medulla. This is called "lumen."

Raine:

1. This fiber has been used in China for thousands of years.
2. It is made from the bast cells from a stingless nettle.
3. These are the strongest and most durable of all vegetable fibers.
4. They are the least affected by moisture.
5. Microscopically, they appear to have knots at regular intervals in the fiber.

Comparisons of Cloth

When two small pieces of cloth are to be compared to determine whether or not they come from a common origin, the following points of comparison may be used:

1. Count the threads of various shades and colors both in the warp and in the weft of each piece of cloth and note the relationship.
2. Count the number of twists per inch of each thread.

3. Note whether the twist is to the right or to the left.
4. Count the number of fibers comprising each thread.
5. Identify the type of fibers contained in each thread.

Often two pieces of cloth may appear to have come from the same origin yet under closer examination they may be completely different. As an example: if two pieces of beige gabardine which appears macroscopically to be from the same origin are subjected to the above analysis, many differences may be noted.

One need only try to match the coat of a new suit to realize the many shades, weaves, and other variations of the cloth.

To Sum Up — Hair and fibers can be of great evidential value as cumulative evidence, but are not conclusive. The more one has to work with, the better the degree of similarity may be established.

IV

FOOTPRINTS AND PLASTER CASTS

Prints and Imprints

It is essential that the investigator differentiate between a print and an imprint, as the method of reproduction and comparison is entirely different in each case. A reproduction of the surface contour of an object may be made by impressing that object into a softer material, then making a cast of the impression. In this type of reproduction, the impression from which the reproduction is made is called an imprint. *Example*: tire tracks in soft earth.

If an object with an uneven surface is brought in contact with a plain, hard surface, such as the top of a table or desk, only the most protruding parts of the object will actually come in contact with that surface. Such a mark left by the object is called a print. *Example*: a finger print on a pane of glass.

Generally speaking, for best comparative results casts are made of impressions, or imprints, while prints are photographed. Photographs of an impression generally have little value, except to show size and shape, unless that imprint is in very shallow material. The author does not wish to imply that an imprint should not be photographed. All prints or imprints should be photographed before the investigation proceeds further. Thus, if through the act of making a cast the imprint is inadvertently destroyed, the investigator will at least have a photograph showing size, shape, and so on. What the author does wish to emphasize is that fine detail sewing, wear pattern, et cetera, of an object (such as a shoe) are not recorded in a photograph of an imprint, for the camera is unable to accurately measure depth.

It is obvious, of course, that most objects may leave either prints or imprints, depending upon the type of surface with which they come in contact, and it is also true that there are all gradations between what would definitely be classed as prints and those that are unquestionably imprints. Shoe impressions

and prints are becoming of increasing value, as many criminals now are fully aware of the potentialities of fingerprints and, to offset this, wear gloves in their work. It should also be pointed out that a person may enter or leave an establishment without allowing his hands to come in contact with anything from which prints could be obtained, yet it would almost be a physical impossibility for him to keep his feet or shoes from contacting some surface.

Although various authors have emphasized the value of shoe prints and imprints in police investigation, very little detailed information is available on the correct procedure which should be followed in order to achieve the best results. Probably the best way to clarify and to outline the procedure is to go through the whole process step by step, explaining each in detail.

Selecting Best Imprints

This subject has been covered to some extent in the introduction, in that the necessity of taking many casts has been discussed. At least one thing is definite. If there is more than one imprint at the scene of the crime, at least two casts should be made, namely, the best imprint that can be found and the one that is nearest the apex of the crime. (If the best print is the nearest one to the crime scene, of course that one cast may suffice.) For example, an imprint is found near the front gate or sidewalk of a burglarized house and is exceptionally clear and distinct. A cast of it should be made. Such a cast may prove that a suspect who is in custody has actually been in the vicinity of the crime. Let us further suppose that imprints are also found under an open window of the house. Even though these imprints may show only size and shape, casts should also be made of them. If it can be shown that they are similar to the shoes of the suspect, they become of increasing value. The one cast proves that he was in the vicinity and the second cast implies that he was near the open window. Of course, if there are imprints of different types of shoes, casts should be made of each type, as more than one suspect may be involved.

The author again wishes to point out that the value of identifiable prints or imprints increases as they approach the apex of the crime. It is sometimes difficult, often impossible, to estimate

from the imprint itself the amount of detail that may be found on a cast. Fine detail before casting is not discernible to the naked eye, and only after a cast is made is it possible to successfully compare it with the shoe.

Preparing an Imprint For Casting

When objects such as leaves, loose rocks, or twigs have fallen into an imprint, they should be removed *only if, in so doing, the imprint will not suffer injury.* If, through the act of removing a stem or a leaf, dirt is caused to fall into the impression, or if a part of the impression is loosened, the cast will be of less value than it would have been, had the debris been left in its original position. When the evidence is later presented in court its authenticity will be accepted by a jury if it can be shown that the impression is as it was found—that no changes were made in it—that the investigator merely poured plaster into that impression and later made his comparison with the shoe.

Figure 31. Casting equipment showing rubber bowl, bottle of water, spray gun, metal reinforcement wire, spatula, and bottle of plaster of paris.

Mixing the Plaster

Because of the ease with which a rubber bowl may be cleaned, it is an excellent receptacle for mixing plaster. A fine grade of dental plaster should be used for casting, as it will bring out detail. The plaster may be mixed in either of two ways. First: fill the rubber bowl about two thirds full of water, then sprinkle the plaster over the surface, allowing it to settle in gradually. When it ceases to disappear into the water with ease, and when some of the dry plaster remains for a short time on the surface, it is generally of the right consistency. The mixture should then be stirred thoroughly with a stiff spatula. It should have the consistency of a No. 20 crank case oil. The second method for mixing is to add water to the plaster in the bowl, stirring constantly. The author prefers the first method, as it seems to give a smoother mix, one which has less tendency to form lumps of undissolved plaster. In either case, should the mixture start to set before it is poured, discard the batch. Do not try to thin it by adding more water, as the resulting cast will be chalky. It will also be slow in setting, oftentimes taking hours. Such casts are easily broken and generally lose much of their detail in the process of cleaning.

Pouring the Cast

The whole surface of a cast should be poured at one time, even though the first layer be very thin. This will insure a smoother reproduction of the imprint. In pouring, allow the plaster to run down the spatula, holding the point of the spatula near the surface of the imprint; this lessens the chance of "washing" or injuring the impression. After the first layer has been poured, and especially in the case of impressions of a whole shoe or tire imprint, some form of reinforcement should be used before adding the second layer of plaster. The best choices are pieces of wire, wire screen, nails, or green twigs. Dry pieces of wood should never be used as reinforcement as they may absorb water, swell, and split the cast. It is not usually necessary to reinforce heel imprints. At least eighteen inches of a tire impression should be cast if it is possible to do so. This will insure a better chance of making a comparison with the tire. Even an eighteen inch cast will represent only about one fifth of the total circumference of the average tire.

Where casts are taken on uneven ground or on a hillside, it may be necessary to devise some method of keeping the plaster from running "downhill" from the impression. This may be done by building a dam of dirt around the cast, but a more satisfactory procedure is to encircle the impression with a flexible piece of sheet metal about three or four inches wide, and about eighteen inches long, which can be bent to any desired shape.

Water in Impressions

If there is water in an impression it should be drained out if possible. Some of it may be carefully removed by means of a large syringe. If a considerable amount still remains in the impression, dry plaster may be sprinkled over the surface until the water is absorbed, then a batch of plaster (mixed in the rubber bowl) poured as previously outlined. Impressions in clay, even though filled with water, may retain exceptionally clear detail.

Imprints in Dust or Sand

Impressions in dust or sand will lose detail if the mixed plaster is poured directly into the imprint. Such impressions can be strengthened to receive the plaster by spraying them with a fifty-fifty mixture of orange shellac and methyl (wood) alcohol. A hand sprayer of the regulation type used in gardening (such as the Hudson sprayer) is satisfactory.

To protect the imprint while it is being sprayed, it is a good thing to surround it with a pasteboard carton from which the top and bottom have been removed. This will prevent the wind from blowing the spray, and will allow the mixture to fall into the impression like a mist. The sprayer should never be aimed directly at the impression until it is sending out a fine spray, otherwise it may jet a stream, ruining the imprint. Two or three layers of the shellac mixture should be applied, and each should be allowed to dry before the next application is made. After the shellac has hardened and a crust has formed over the surface of the impression, the plaster may be mixed and poured as previously outlined.

When a cast is made in this manner there will be a coating of shellac still adhering to it. This condition may be averted by

spraying the impression with a light coating of very thin oil after the shellac coating has hardened and before pouring the cast. If the above procedure is not followed and a shellac coating adheres to the cast, it may be removed with wood alcohol.

Removing Casts

If a cast has been poured correctly it should set or harden within approximately fifteen minutes to a safe consistency for removal. The spatula mentioned previously is a good tool for this purpose. Dig all the dirt away from the sides of the cast, leaving it on a dirt pedestal, then thrust the spatula at an angle downward at various places around the cast. This will loosen the dirt sufficiently to allow the cast to be removed without breaking. It is not a good procedure to try to remove too much of the adhering dirt at this time, only that which comes off with ease; rather, allow the cast to harden before attempting to completely clean it.

Cleaning a Cast

Generally an investigator is anxious to know the type, size, and, if possible, the make of shoe that has made the impression. Many times this information is an essential element in his investigation. For this reason, if he does not have time to take the cast to the laboratory, he may, if he is careful, clean the cast himself without injuring it. The cast should be allowed to set at least three hours, and it is even better if it can harden overnight.

A cast is cleaned by placing it under a gentle stream of tap water and going over the surface of the sole carefully with the flat or palm surface of the hand only. This procedure removes the dirt from the higher portions of the cast, but leaves it in such depressions as nail holes, sewing, and irregularities. This method of washing brings out contrasts which are essential for comparison with the shoe. No brush of any kind should ever be used. It is better to leave too much dirt on the cast than to destroy detail. Dirt can be removed later, but identifiable characteristics, once destroyed, can never be replaced.

When a cast has been made from an imprint in dust previously sprayed with shellac, even though that shellac be removed, it is difficult to see detail because of the lack of contrast; in other words, the cast will appear white both on the higher portions and

in the depressions. It is possible to restore contrast on such a cast by first soaking it in water and then coating it with some dark colored mud. It is then allowed to dry and is rewashed. The cast will then appear as though it had originally been poured in dirt, and the identifiable characteristics, so necessary for comparison, will stand out.

Marking Casts

Each cast should be marked for identification, preferably when it is removed from the ground. Such markings should include the address of the premises, the date, the time, the officer's initials, and the case number if such a number is used. When several casts are made at the same location, the casts should be numbered (1), (2), and (3). All markings should be scratched in the back of the cast. Marks made by a pen or pencil on the surface of the cast are not satisfactory, as sometimes they are erased when the cast is washed. The number of each cast should be entered in the officer's notebook, along with a notation describing the original location of the cast.

Transporting Casts

The same care should be taken when transporting a cast as is taken with a fine piece of crockery or glassware. If the casts are to be taken directly to the laboratory they may be placed loose in a pasteboard carton or carried on the floor in the back part of the car, but if they are to be shipped they should be packed carefully in a wooden box, and the box labeled "glass."

Locating Prints on Hard Surface

Prints made in dust on hard surfaces are not always visible in daylight or in the normal room lighting found in most places of business. In order to search for the possibility of prints it is advantageous to have a 500 watt photoflood light in a bell-shaped reflector. All other lights should be darkened, and the photo flood played obliquely over the suspected surface. If prints are located and the object on which they are found can be conveniently transported to the laboratory for photography, that procedure should be followed. Where prints are found in such places as on a tar paper roof, or on objects too large to be moved, they should be

Figure 32. Photographing footprint with oblique light. Note camera perpendicular to print and position of light.

photographed at the scene. Prints on tar paper roofs should be photographed at night, using a photo flood with an extension cord; if this is impossible, a spot light attached to a hot-shot battery will suffice.

Photographing Prints

As previously stated, prints made in dust on hard surfaces should always be photographed. It is also possible to lift such prints with a new method, using a sheet of neoprene. A company has developed an excellent piece of material for this purpose —far superior to the old method of using a photographic negative as the lifting medium. The neoprene sheet has a tackiness which is exactly correct for this purpose. It is also possible, through this method, to accurately lift prints from newspapers or other papers where printed data is obscuring the evidence. The equipment is easily cleaned, and can be used over and over. However,

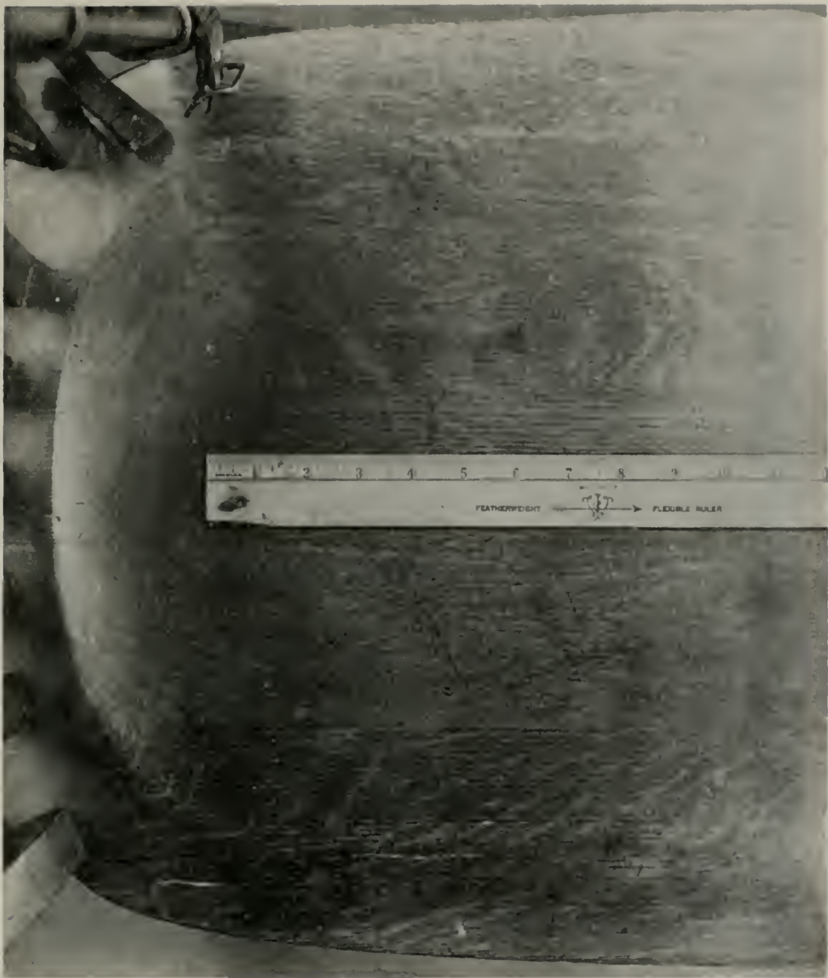


Figure 33. Photograph of the seat of a chair on which there are two shoe prints. They are completely invisible under normal room lighting.

even though the print at the scene is to be lifted, it should first be photographed.[1]

In photographing prints there are five essential things to keep in mind. (1) The camera must be placed directly above and

1. James Watson, "A Method of Lifting and Photographing for Evidence." *The Journal of Criminal Law, Criminology, and Police Science* 49:89-91, May-June, 1958.

perpendicular to the plane surface on which the print is found. (2) A strong light should shine obliquely over the surface of the print, with all other light sources blacked out. (3) A ruler must be near the print to indicate size. (4) Some means of identification must be near the print, and should include the information previously described in marking a cast. (5) Photograph actual size or smaller.

The camera used should have a ground glass back and should

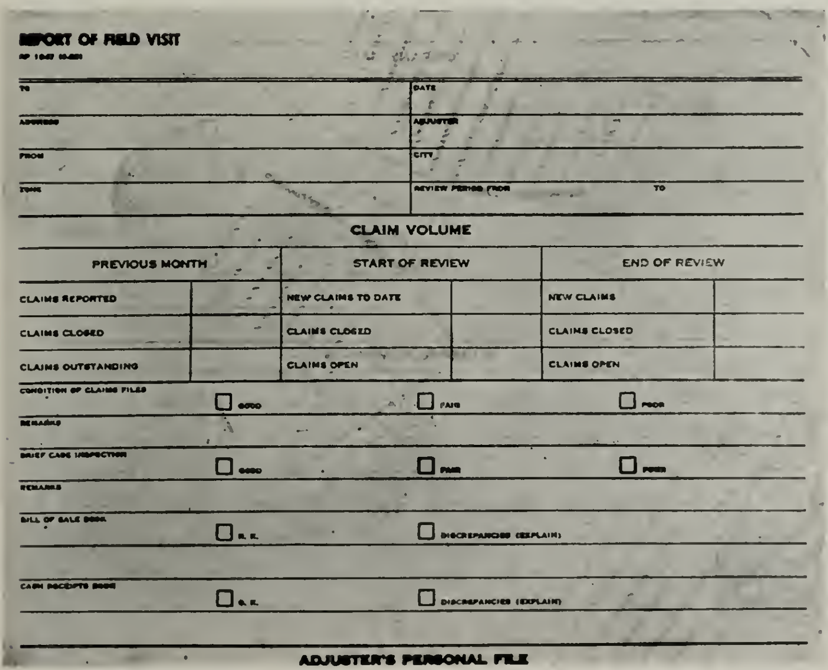
Figure 34. Same chair seat, Illustration 33, using photo flood played obliquely across the surface with all other lights out.

be mounted on a tripod. After the room has been darkened, the photo-flood is played over the print until the best image is obtained in the ground glass. Then, after the position at which the light is held has been noted, a film holder is inserted and the photograph made.

Comparison of Prints and Imprints With the Object That Made Them

An imprint or print may be proved to have been made by a certain object if there are a sufficient number of similarities and a total absence of unexplainable dissimilarities between it and that object. The first step in comparison is to note any fundamental differences between the object (such as a shoe) and the suspected print or imprint. A fundamental difference is a difference which precludes any further comparison. In other words differences in size, shape, or make. If there are no fundamental differences, points of similarity should be located and recorded.

Many things are considered to be points of similarity. To


REPORT OF FIELD VISIT

TO | DATE

ADDRESS | ADJUSTER

FROM | CITY

TOWN | REVIEW PERIOD FROM | TO

CLAIM VOLUME

PREVIOUS MONTH		START OF REVIEW		END OF REVIEW	
CLAIMS REPORTED		NEW CLAIMS TO DATE		NEW CLAIMS	
CLAIMS CLOSED		CLAIMS CLOSED		CLAIMS CLOSED	
CLAIMS OUTSTANDING		CLAIMS OPEN		CLAIMS OPEN	

CONDITION OF CLAIMS FILES ☐ GOOD ☐ FAIR ☐ POOR

REMARKS

BRIEF CASE INSPECTION ☐ GOOD ☐ FAIR ☐ POOR

REMARKS

BILL OF SALE BOOK ☐ O.K. ☐ DISCREPANCIES (EXPLAIN)

CASH RECEIPTS BOOK ☐ O.K. ☐ DISCREPANCIES (EXPLAIN)

ADJUSTER'S PERSONAL FILE

Figure 35. A photograph of shoe prints on lined paper; using the best lighting facilities possible, print is still only faintly visible.

Figure 36. Same prints lifted by neoprene method.

enumerate a few—(1) wear patterns, (2) worn condition of nail holes, (3) parts of the object chipped or broken away. In other words, any peculiarity on the surface of the object which is the result of wear or usage and which is transferred to the print or imprint may be considered as a point of similarity.

Explainable dissimilarities are differences between the object and the print or imprint that can be explained. For example, a dust print on a piece of paper is only partially complete—only a part of the heel has been reproduced on the paper. This may be explained in a number of ways. Perhaps only a portion of the heel was impregnated with dust, or perhaps the surface beneath the paper was uneven. When such a condition can be explained, a comparison is not precluded. Even as in the comparison of fingerprints, a portion of a heel print, if it has a sufficient number of similarities, may be definitely identified as having been made by a certain shoe.

We have been discussing comparisons in general, which may apply to both prints and imprints, but the actual comparative

procedure is different for each. A cast made of an imprint or impression in a soft surface is a positive reproduction and can be compared with the object itself, or with a cast made from another imprint of that object. A photograph of a print on a hard surface is a negative reproduction, and should be compared with an inked print made by the questioned object, and not with the object itself. For example: if the right hand were placed palm down on a hard surface and the resulting print photographed, the thumb would appear to be on the left side, but when the hand is turned over for comparison the thumb would be on the right side, and the comparison would be of unlike objects. A fingerprint is never compared with the finger itself, but with another print made by that finger. The same thing is true in other print comparisons, such as those made of shoes or tires.

Sometimes a suspect walks through fine dust, as is normally present in attics, and then transfers this dust to such surfaces as dark colored desks, chairs, linoleum, et cetera. When such is the case a photograph of the print will show it to be lighter than the

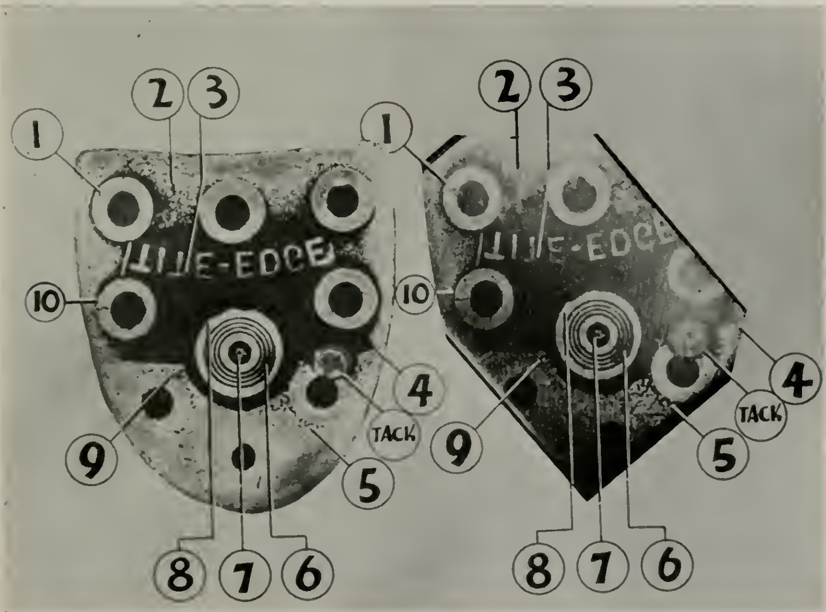


Figure 37. Photograph on right taken with fingerprint camera; photograph on left, a print made by suspect's shoe. A foot print can be just as identifiable as a fingerprint.

background. If, however, the same dust-coated heel came in contact with a piece of white stationery, the print would be darker than the background. When the print is darker than the background, comparison with inked prints made by the shoe is relatively simple. In both cases one is dealing with the darker print on the lighter background, and points of similarity may be readily noticed, but when the print is lighter than the background it is difficult to make reproductive prints of the shoe for comparison in the same colors; in other words, the exemplar made by the shoe for comparison will be a dark inked print on a light background, while the print in question is a light dust print on a dark background. Such points of similarity as may be present will not be readily discernible. If the inked print made by the shoe is photostated actual size, the colors are reversed, and the two prints may be compared as in the previous instance. This will also greatly aid the officer in presenting his evidence to the court. The author has found, in presenting such evidence in court, that the more nearly alike the print and the exemplar look, the easier it is for the judge and the jury to understand their points of similarity.

When exemplars are to be made using the heel of a shoe as the object, that heel should be pressed onto an ink pad and a series of prints made with that heel on a white paper surface without reinking. This will insure exemplars of varying densities, ranging from the very dark to those that are only faintly visible. It may be necessary to go through this procedure a number of times, and to select from the many exemplars those that most nearly correspond in density and in characteristics with the questioned print previously photographed at the scene of the crime. Again, it is a comparison of like against like. When a number of prints are made with a shoe, using only one inking, it may often be noticed that there are varying changes in characteristics. For example, the higher portions of the heel will make the darkest lines in the beginning, but will lose their ink first and may, after a number of prints have been made, actually leave no impression at all. In a certain murder case, the author made over two hundred and fifty inked prints, using the heel of the suspect's shoe, before he was able to get one with sufficient characteristics to definitely identify that shoe as the one which had left a bloody

print on a piece of corrugated box top found partially under the victim's body. In this case the blood on the heel of the shoe had not been uniformly distributed, but had been picked up when the killer had walked through blood-spattered grass, thus explaining the difficulty involved in trying to simulate the print on the cardboard.

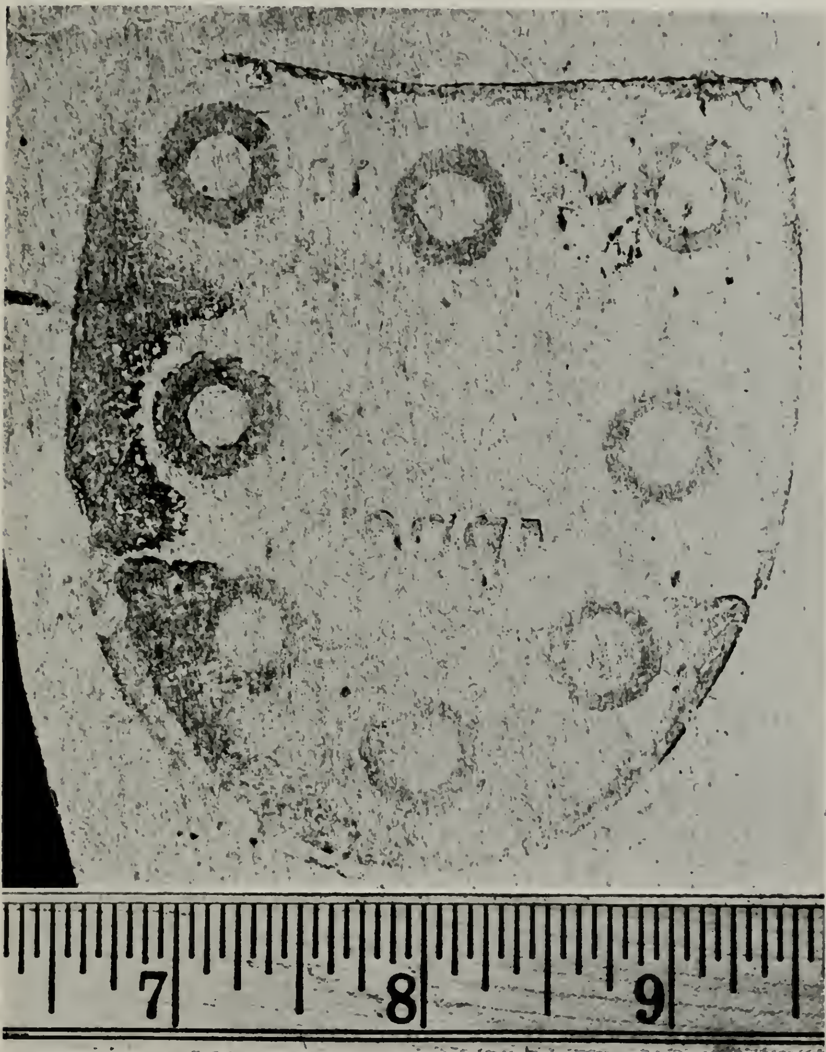


Figure 38. Print found on piece of cardboard lying partially under a body of a murdered victim. Note small circular break in lower left hand side.

Figure 39. Rubber heel of shoe of suspect; notice photograph of heel was reversed, thus bringing the outstanding characteristic (cut in edge) on the same side as print from scene.

Transparencies

If a photographic negative is made exact size of each of two prints to be compared, and then a positive transparency is made of one and is superimposed over the other, characteristics of simi-

larity will coincide. This procedure is very effective in getting over to the court the similarities and the points of comparison that otherwise might be difficult to see.

Comparing Tire Casts With Tire

A cast of a tire imprint may, as a preliminary step, be compared directly with the tire itself. If points of similarity are found

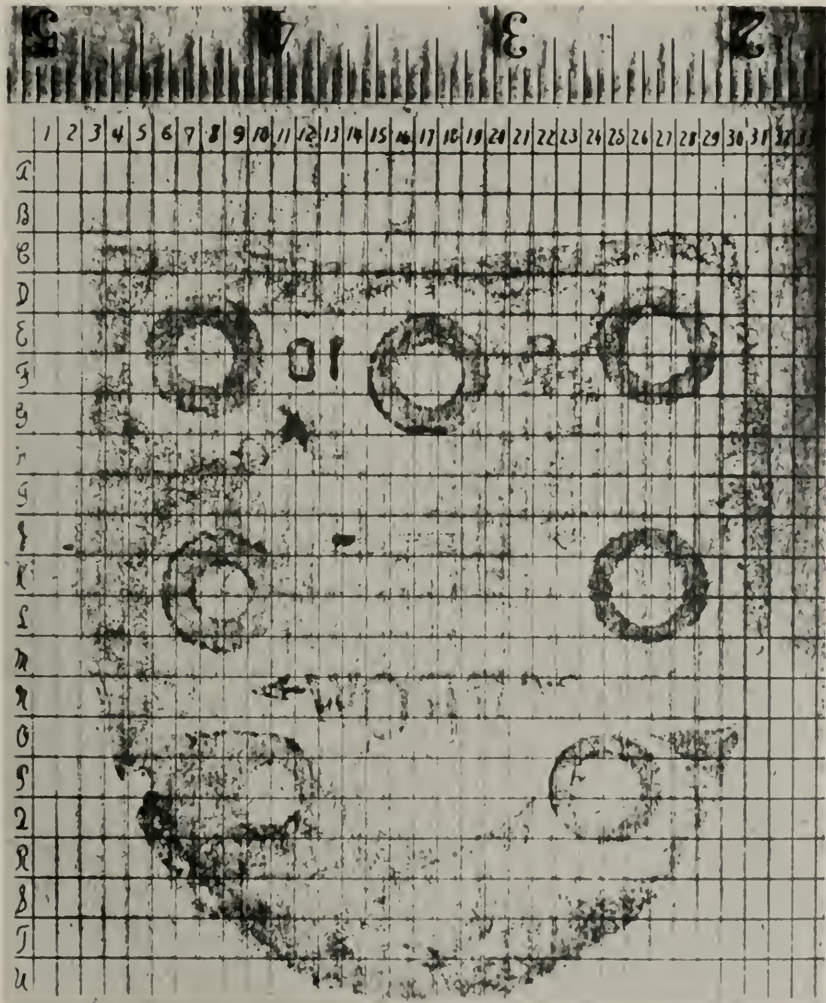


Figure 40. Photograph of exemplar print made by shoe (Illustration 39) using a lined glass overlay for more accurate comparison. The exact location of each imperfection may be measured through this method.

on a specific portion of that tire, then another imprint should be made of that portion and a cast made of the impression. The cast may then more easily be compared. It is very difficult for the court or jury to see points of similarity between a flat white cast and a black oval tire, no matter how obvious they may appear to the trained eye. The same situation may be true in a cast-shoe comparison: this is usually due to differences in color and material.

The author wishes to reiterate that whenever any type of comparison is made, whether it be casts, tool marks, or other forms of physical evidence, it is generally true that the more closely these objects resemble each other in color, shape, and texture, the more easily such comparison may be understood by the court.

When a cast is compared with a suspected tire and no specific points of similarity other than type and depth of tread is found, it is possible through the use of transparencies to compare the relative amount of wear of each. The circumference, or total distance around the outside tread portion of a tire, is shortened 3.14 inches for every half inch of the tread worn off, as shown by the formula, Circumference = Pi D. Thus if casts made from imprints are photographed exact size and one of these photographic negatives is superimposed on the other, slight differences in the longitudinal plane will be obvious even though not noticeable otherwise. Through this method it was possible to show the similarity in degree of wear between the imprint found at the scene of a murder and a tire on the suspect's car. It was also possible to definitely eliminate the three other tires on that car, even though all were the same make and had traveled an equal number of miles.

Special Notes

Plaster casts and photographs of prints which are taken at scenes of various crimes should be retained in the laboratory for at least a year and a half. Probably two years would be better. Many times perpetrators of crimes may store the shoes they have used, and an identity is possible even after a considerable time lapse. The author had one case in which he was able to identify the shoes of a burglar as having made certain prints at the scene of a crime which had been committed fifteen months previously.

The burglar stated that he only used these shoes on burglaries.

Sometimes shoes may pick up tacks, small rocks, pieces of gum, tar, et cetera, which leave a characteristic identification on the prints made at the scene of a crime. Shoes that have stepped in blood, oil, or inks, later leaving prints at various crime scenes, may be analyzed for such substances. The thread used for sewing the sole is especially absorbent for liquids.

In emergencies, heel prints on floors and other flat surfaces may be photographed with a common fingerprint camera. The main disadvantage in this procedure is that the fingerprint camera is not large enough to photograph a complete heel print, and definitely is of little value where a whole shoe print is involved.

A shoe may leave an imprint in soft dirt that is slightly larger than the shoe itself, due to the squashing effect which may result at the time the imprint is made. In muddy ground it is possible for conditions to be reversed, in that the imprint may often be slightly smaller than the shoe itself, due to the flowing-back effect of the mud after the shoe is removed. Thus, even though there are slight discrepancies between the exact size of the cast and the shoe, these do not necessarily preclude an identifiable comparison. Generally there is no difference in size between a shoe sole and a print made by that sole on a hard surface; the only exception is a thick crepe sole, which has a tendency to leave a print slightly larger than the shoe.

Often a defense attorney may make an issue of the method used in preparing exemplar prints for comparison. He will point out that it is impossible to exert the same pressure as the defendant would have done had he made the questioned prints. That statement is definitely true. As a matter of fact, the pressure exerted by the defendant differs to some extent with each step he takes. For instance, a hundred and fifty pound man walking downstairs may exert as great a pressure on the sole of his shoe as would a two hundred and fifty pound man walking on level ground. A man running may exert as much as two or three times the pressure of his natural weight, so it may be extremely difficult to duplicate the exact pressure when making exemplars, thus the aforementioned suggestion that as many exemplars as possible be made, and the ones that most nearly correspond to the questioned print be used for comparison. The important point to emphasize

to the court and jury is the fact that there was a print or imprint left at the scene of the crime, and that by using the defendant's shoe it was possible to make a number of exemplars which show them to be the same make, size, and shape; that they have the same general overall appearance, and that there are certain specific points of similarity, and that in the opinion of the expert all prints or imprints were made by the same shoe.

In photographing a print or imprint, the negative should never be made larger than exact size, as it is easier to make an enlargement than to reduce it. Even though enlargements are made for court they should be accompanied by photographs of exact size, as the latter will then correspond to the object itself.

V

POLICE PHOTOGRAPHY

The saying that one picture is worth a thousand words is graphically illustrated through police photography. No case is complete unless all necessary photographs have been systematically taken for presentation in court. The officer or another witness may describe with great accuracy the conditions at the scene of the crime as he found them, yet his description will often be interpreted by the twelve jurors in twelve different ways.

To visualize a description of a wooded area or field is to reconstruct the picture in the mind of its similarity to a locale with which one is familiar; yet if shown a photograph of that same area one may readily note differences from any place that he has ever before seen.

Police photography may be divided into a number of phases: (1) photography of prisoners (mugs); (2) photography of crime scenes; (3) photomicrography; (4) laboratory technique (enlarging, printing, photostats, et cetera).

Photographing of Prisoners

Photographing of prisoners can be more or less standardized. If the department is small, a good mug camera with a seven and one-half inch lens mounted on a tripod will suffice. A simple but accurate mugging setup can be hand-constructed without a great deal of difficulty. A camera is mounted on an adjustable platform, about five feet in length, which may be raised or lowered by a ratchet. The front end of the platform is cut in such a way as to permit the chest of the prisoner to press against it. The camera is located on the platform approximately four feet from the prisoner. The subject, standing in this position, should be in exact focus, and the angle of the lens is sufficiently large to include the upper half of his body. The booking number should be mounted on a holder attached to the platform directly in front of the chest of the prisoner. The camera back must be per-

pendicular to the prisoner; canting either up or down will cause the subject to be out of the true focal plane, and distortion will result. A scale showing height should be within the same approximate focal distance as the prisoner, either at his left or right side. To have the background scaled for height will not give a true perspective as to the person's actual size. The background should be gray.

The photograph of the prisoner should record as nearly as possible the individual's true color. In other words, an exceptionally dark negro should appear in a mug photo as an exceptionally dark negro, not as a mulatto. Far too often witnesses, after looking at the photograph of a suspect, will say, "That looks like the man, but he was much darker," or "His hair was a lighter shade" or "His complexion was more ruddy." The taking of correct mug pictures is very important, for often it is through them that some murderer, rapist, or kidnapper may be positively identified.

A standardized lighting system should be used, preferably of the flash type, as a drunk will have a tendency to move during a time exposure, and the smart prisoner may intentionally drop his head, or make some other movement, hoping to produce a picture inferior in quality. A set of Strobe lights are found to be excellent for this purpose. They should be permanently mounted at various angles to give the best results. The location may be determined through experimentation.

Stand Ups

It would be an excellent practice if all felony prisoners could be photographed full length, as witnesses are better able to identify a suspect if they can see him in his entirety. His posture, the appearance of his clothes, the length of his arms, and numerous other characteristics not shown in a mug photo may be of infinite value in securing an identification. Stand ups may be successfully taken either through the use of a camera mounted on a tripod or with a regular studio portrait camera; the latter, of course, is preferable. Again, the scale showing height should be placed in the same focal plane as the subject. Where two, three, or more suspects are believed to be involved in a specific crime, they should be photographed standing side by side. This

will allow the victim to gauge their relative heights, thus aiding him in making an identification.

The camera used for stand-ups should be located at a definite distance from the line where the suspect is required to stand. This location should be maintained whether the suspect is tall or short. In other words the camera is located so that a man six feet six inches tall will approximately extend to the top of the negative vertically; then a four foot individual should occupy a space in the negative to a corresponding degree. Thus a tall man will appear tall and a short man will appear short. Remember the only reason for taking photographs of prisoners is to be able to use them for identification at some future date; therefore every effort should be made to accurately portray their true characteristics. If they are fat, let the camera show them to be fat; if they are stoop-shouldered, see that that characteristic is truly reproduced in the photograph.

If the prisoner has some outstanding characteristic, such as a definite scar on the face or hands, and the photograph can be made to include that, it will be an excellent means of identification at some future date.

Photography of Crime Scenes

To describe the scene of a murder with a degree of accuracy which would enable each and every juror to clearly visualize that scene is difficult, if not impossible. How much easier it would be to show a photograph of a circular stairs to a person who had never seen one than to try to describe it. We might even say that the camera acts as the eyes of the investigator in recording and presenting the scene of a crime, yet it has one distinct advantage. It sees all of the scene at one time and so records it, while the investigator must repeatedly scan the same scene to retain the picture in his mind; even then he will have rare ability if he can retain everything. Photographs of a crime scene often reveal objects and conditions which were passed unnoticed by the investigator.

Photography at the scene of any crime may be divided into four general classifications: (1) general view, (2) medium view, (3) closeup, (4) extreme closeup.

General View

The general view should include photographs of the surrounding territory. It should show the property intact with respect to the neighborhood in which the crime was committed. Photographs of this type would include those taken from across a street, showing the name on the front of a burglarized store, the street number, and may possibly include the store on each side, if any. This photograph may later be used as a general means of identifying the locality in question, and it will help to orient the jury as to the surrounding terrain.

Medium View

Medium view photographs include those taken within ten to twenty feet of the object. They will show the specific object desired or they may be taken of places of entrance or exit and will be of sufficient size as to enable the jury to tie them in with the general view photograph.

In any series of photographs those taken of a smaller area should include some article which also may be seen in the more extensive view. This will tie the series together.

The Closeup

The closeup photograph should clearly show some particular item of interest. It may be a gun, knife, tool marks on a window, footprints on a chair or floor, or anything of particular importance. These photographs are generally taken at a distance of from four to six feet and should again include some identifiable object which is also depicted in the medium view photograph.

Extreme Closeups

This type of photograph is taken at a distance of one foot or less, as the case may warrant. It may clearly show scratch marks, minute spurts of blood, or other characteristics too small to be distinctly shown or recognized in any previous shot. A photograph taken at this distance should also include a rule or scale so that the final print may be accurately reproduced for comparison. It is essential that correct lighting be used for this final operation, so as to obtain the best possible results.

Flash type illumination, although excellent for making con-

sistent photographs of larger areas, is not the best type of lighting for extreme closeups. Generally, this type of photography can be done more accurately by using a photoflood and time exposure. In taking the extreme closeup the back of the camera is opened and the area is viewed through the ground glass; the photoflood is moved to various positions until the best reproduction of the image is obtained, then the f opening is stopped down and the photograph is taken with the light in the exact position. Again certain characteristics that appear in this photograph should also appear, even though smaller, in the normal closeup.

It becomes very important to be able to convince a jury that a mark such as a blood spot, footprint, or other piece of evidence was located at some exact place relative to the scene.

In a certain Los Angeles homicide, a footprint was found on a piece of cardboard near the feet of the victim. It became of paramount importance to show to the jury the exact origin and relationship of this print to the body. The print was positively identified as having been made by the defendant. The question was raised by the defense as to whether it was actually found at the scene. A portion of the general view of the body and surroundings was enlarged to show that the print was in that specific location, as stated by witnesses.

Equipment

Photographic equipment used for field work by a police laboratory should be the best obtainable. This does not necessarily mean the most expensive. A good lens costs money, but it is one of the best investments that can be made and is one part of the camera that should never wear out. Shutters must be accurate and dependable, as shutter failure can be disastrous. The camera itself should be of rigid construction and should afford an ease of operation. Probably the best field camera is a press or graphic type. It is easy to operate, is of rigid construction, and has become very popular in all field photography. A camera should be synchronized for flash, but photofloods are also a necessary component of a complete field kit. There are many types of photography at crime scenes where the latter is absolutely essential. The kit should also include a very sturdy tripod of such a type as to enable the camera to be pointed perpendicular to the floor

for photographing footprints, et cetera. A short tripod capable of lowering the camera so that photographs may be made in a horizontal plane of objects such as hub caps, bumpers, et cetera, is a valuable addition to a field kit. The kit should also include a fifty foot tape and six inch rulers, the latter in various colors, including one of transparent plastic. It should also include film holders containing various type film.

If the assets of the department will permit, a 35 mm camera, loaded with color, will be found excellent for accurately reproducing the scene. Some of the better cameras of this type are the Contax and Leica, yet excellent results may be obtained with a less expensive camera such as an Argus or an Eastman. Twenty color photographs of this type cost only about three dollars and are very effective if projected in court.

Photographing Homicide Scene

Even though the photographer is responsible for the technical aspects of photography, it is the responsibility of the investigator to see that the scene of a murder is thoroughly photographed from all angles. He may have information, obtained from various sources, which the photographer does not have. For instance, a witness may state that he was standing in a certain location, thus a photograph should be made from that location at approximately the eye level of the witness. The investigator should see that the victim and the murder scene are photographed from all angles, including one from directly above. Bullet holes in walls, et cetera, should be photographed from a distance. This photograph should include the body and other objects, for orientation. Then the camera should be moved in and a closeup made of the hole. This procedure should also be used in photographing blood spots, broken furniture, weapons, and footprints. A complete photography of the scene should also include outside photographs of the surroundings and other rooms of the house, showing derangement of furniture, bedclothes, et cetera. Possible points of entrance and exit should also be photographed. Whenever possible, *all preliminary photography of the scene of a homicide should be completed before the body or any object is moved or disturbed.* As the investigation proceeds, the photographer should stand by to make any additional shots that may be re-

quired. Often as the body is being moved, conditions arise which necessitate additional photography. Even twenty-five to fifty dollars worth of photographs at a homicide is cheap compared with the results obtained.

During the photography of a murder scene a small wooden block, about a two inch cube, with a compass countersunk in the top may be used to advantage in each photograph. It should be placed on the floor in such a position as to show the true direction from which that photograph is made. Closeups of the physical condition of the body such as gaping wounds, a knife still piercing the body, a rope tied around the neck, or any injury plainly visible, should be made while the body is still in its original position.

Photography at Burglary Scene

Although photographing a burglary scene may not necessitate covering the area in such detail as does a homicide, yet certain photographs are essential. Such objects as opened safes should be photographed from various angles. Closeups should also be made of the lock of the safe door, the condition of the contents, the location of any tools, et cetera. If it is a blow job the burglar may have used blankets, rugs, or clothes to deaden the noise. Photographs should be made of the locality from which these were taken if they came from the immediate area. A complete series of photographs should be made, beginning with the outside of the premises at the place of entrance and continuing throughout the building to and including the exit. Ropes, or ladders found leaning against the building, should be photographed. When the entrance is through the roof, conditions from above should be reproduced photographically. Often the question may arise in court as to whether or not the defendant could have entered through the alleged place of entrance, such as a hole in the roof, a ventilator or a window, therefore it is essential that a yardstick be placed along one side of the entrance. This will eliminate much controversy later in court. Again the responsibility for designating what is to be photographed lies with the investigating officer. He will have more information pertaining to the case than anyone else.

One of the most important types of evidence often passed up

at the scene of a burglary, is a footprint or an imprint. Latent footprints may be located if the scene is darkened and a photoflood is played obliquely over the area. This type of lighting will cause them to stand out in sharp relief for photographic reproduction. At times burglars may leave prints on tar paper roofs. Photographing these in daylight is unsatisfactory. Such prints should be photographed at night, using a photoflood for oblique lighting. Tool marks may be photographed at the scene if the object on which they are located cannot be transported with ease to the laboratory. The best tool mark comparison, of course, is accomplished through the use of the comparison microscope, and this should be done in the laboratory.

Photographing Robbery Scene

At the scene of a robbery, in addition to the victim, there may have been witnesses present. It is therefore important that photographs be made from the exact spot or spots where witnesses were standing at the time the crime was committed. This may verify their statements as to what they were able to see. It enables the jury to place themselves in the apparent position of that witness. Such objects attacked during a holdup, which may include safes, cash drawers, cupboards, closets, et cetera, should also be photographed. Their locations should be tied in with the overall scene of the premises. If the victim was injured all wounds should be photographed. This, of course, may be done later at the laboratory or the hospital, as the case may be. Remember, the trial may not take place for months; during this time the wounds of the victim may have healed, and the jury might minimize the extent of the injury if the case depends solely upon his testimony.

Attack Cases

In attack cases the premises should be thoroughly photographed. Articles used to tie up victims, derangement of bedclothes, blood stains, or any other object pertinent to the case should be photographed. Broken shrubbery, weeds, or plants that have been trampled down, showing the extent of movement in the vicinity of the attack should be photographed, also the extent of wounds of the victim, and torn articles of clothing. The

more thoroughly the actual conditions are photographed immediately after the attack, the more clearly the jury will be able to see the actual conditions.

Other Cases — General and Special

It may not be necessary to photograph all types of crime scenes, but when it is thought necessary to photograph a scene at all, that scene should receive full coverage. Often the seemingly unimportant crime may develop into one of great importance, even a homicide. What may appear as a natural death and is neglected photographically, such as a drunk lying in an alley, may later turn out to be a criminal case. One cannot accurately re-enact a crime scene once the details have been changed.

The investigator need not concern himself as to whether a particular photograph may be made with ease or with great difficulty. That is a problem for the photographer. He must devise ways and means of photographing any object or condition that the investigator feels will be of value to his case. If the investigator does not care to divulge any information to the photographer, then he should personally point out each and every picture to be taken, so as to insure adequate coverage.

Photomicrographs

Photomicrographs are purely a laboratory problem. They may consist of photographs taken of objects magnified anywhere from two or three diameters to five hundred or more, and are made to show to some extent that which the expert was able to see as he studied the object microscopically.

The author has been asked many times by the defense attorney if he arrived at his opinion through a study of the photomicrographs submitted. The answer, of course, is no. The expert arrives at an opinion after a thorough study of all the ramifications of the case, and it would often be a physical impossibility to photograph each and every detail that aided him in reaching his conclusion. For instance, he may study two bullets through the comparison microscope, searching each land and groove and comparing all the characteristics of the entire circumferences of the bullets, yet to photograph all of these characteristics would be

impractical, if not impossible. The best point or points of comparison should be selected and photographs made of these characteristics.

It may be impractical to make photomicrographs of some particular piece of physical evidence, such as a small piece of paint or other minute object. Unless the photograph will clearly depict the characteristics of the evidence, it is better for the expert to rely solely upon his testimony in court. He should never try to show the object through the microscope to a jury. It is difficult to find twelve members of a jury who all have had previous experience with the use of the microscope. They may look through it and see nothing, yet feel too embarrassed to acknowledge that they were unable to see the evidence purported to be present, but when they later retire to the jury room they may argue with other jurors as to whether or not such evidence exists.

Photomicrographs in Color

Photomicrographs in color may be taken with a Contax or other camera of similar make, and are an excellent means of portraying to a jury the true appearance of certain types of evidence —paint consisting of many layers, a minute spurt of blood, various colored fibres, or other pieces of physical evidence where color comparison of the objects is important. When evidence of this type is photographed with 35 mm color film and projected in court it enables the expert to get over to the jury his findings with an accuracy which would be impossible for him to do with black and white. Some difficulty may be encountered at first in getting such photographs admitted as evidence, as that type of photography is somewhat new. They should be made and entered by an expert photographer who is thoroughly qualified in color photography and who can stand up under a stiff cross examination. After such evidence has been entered in a number of cases, and the courts of the locality have become accustomed to their use, the precedent will have been established, and little difficulty will be encountered.

The author has found that projecting color photographs on a screen is by far the simpler process. To make actual color prints entails a great deal of work and precise technique, and even then the colors generally are not as true as when the film is projected.

Stereoscopic Photographs

Stereoscopic photography is important where indentations, ridges, perforations, or other irregularities of the surface of an object are of evidential value. As an example, it may enable a jury to see why a certain portion of a heel print is missing; the missing portion may be due to some slight depression of the surface on which the heel print is found. To the naked eye this is not always discernible, but when stereoscopic enlargements are made it may be obvious. Stereoscopic pictures in color often are excellent means of portraying true characteristics of evidence that the expert wishes to bring out. Stereoscopic pictures may be shown to the jury through the use of hand stereopticon viewers or, with a somewhat greater outlay for equipment, they may be projected on a screen and viewed by the court and jury at one time.

Infra Red and X-Ray Photography

Infra red photography is excellent for bringing out deleted pen and ink writing. It may also be used to advantage in identifying the signatures on paintings of old masters or on other objects where a color separation is of importance. X-ray photography has been used on the latter with some success. Fingerprints of a decomposed body, or a body that has been in a fire, have been identified through X-ray photography. Loaded dice may be photographed by means of the X-ray, and may show small deposits of metal beneath the spots on the dice. In a certain Los Angeles case a burglar was hit with a load of birdshot as he fled through the door of the burglarized establishment. He was not arrested until a month or two later. At the time of his arrest he would not permit any of the shot to be removed from his body for examination and comparison with the shot found embedded in the doorsill. An X-ray photograph of the shoulder pad of his coat disclosed six shot; these were removed and compared microscopically and spectrographically with the shot recovered from the doorsill. This aided in obtaining a conviction.

X-ray photographs or a fluoroscopic examination of homemade bombs, infernal devices, et cetera, may establish the working mechanism inside and thus aid the expert in being able to safely dismantle the object.

X-ray photographs taken through walls, davenports, upholstered chairs, or other places in which bullets have been embedded may greatly aid in the recovery of the bullet.

Preparing Photographic Exemplars for Court

Correct preparation of photographic exemplars is of great importance as a means of chronologically showing to the jury the various elements of the case. As an example, in a case where a screw driver was used to pry open a strong box, and the fact is established through tool mark identification, the following photographic exemplars should be made, and all mounted on one cardboard:

1. A photograph of the screwdriver, actual size.
2. An enlargement of the end of the screwdriver, showing its irregularities.
3. A photograph of the tool mark, actual size.
4. A photograph of an exemplar made with that tool, actual size.
5. An enlargement of the tool mark.
6. An enlargement of the exemplar.
7. An enlargement showing a comparison of the tool mark and the exemplar through the comparison microscope.

These seven photographs should be mounted chronologically on a large sheet of mounting board, each identified with a brief caption beneath it. Preparing a set of photographs in this manner aids the jury in understanding the procedure one followed in making the identification. Each photograph on the board should be outlined with a black ink line and a similar line should be drawn about 1/8" from and parallel to the outside edges of the board. This will give the whole display a finished appearance. Displays for court should be neat, accurate, and the lettering should be of uniform size.

A thought to keep in mind: if you can see it, you can photograph it, and that photograph may be the difference between conviction and acquittal.

Suggested list of equipment for a complete police photography field kit:

1. speed graphic camera, complete with 5" lens, coupled range

finder, flash gun, spot reflector, and pan reflector for large bulbs.

2. 1 extension flash unit (slave light).
3. 1 lens shade for 5" lens.
4. 1 wide angle lens and lens shade.
5. 1 tape measure.
6. 1 box of white chalk.
7. 1 ball of string.
8. 1 compass, mounted on top of a block of wood 2" cube, painted white, with N, E, S, W painted in black letters on the sides.
9. 2 tripods, 1 standard, 1 with very short legs.
10. 1, 8" mirror.
11. 1 exposure meter.
12. 3 filters, yellow, red, and green.
13. 1 photoflood reflector #1.
14. 1 flashlight.
15. 1 polarized filter.
16. 4, 25' lengths of extension cord.
17. 12 to 14 film holders, some loaded with high speed panchromatic to be used for normal photography and footprints, a few loaded with ortho for photographing blood spots. If no color camera is included in the kit a few holders should be loaded with kodachrome for color shots.

Forty-four possible sources of error in police photography between the crime scene and the presentation of finished prints in court:

Pertinent Subject Material

1. Failure to include pertinent objects.
2. Canting of camera, causing distortion.
3. Failure to cover scene completely.
4. Shot from wrong angle.

Mechanical Errors

5. Shutter fails to open.
6. Shutter fails to close.
7. Flash cord failure.
8. Solenoid failure.
9. Dead battery.
10. Wrong f stop (over or under).
11. Failure to cock shutter.

12. Film not seated properly (out of focus).
13. Defective flash bulbs.
14. Out of sychronization.
15. Improper use of filters.
16. Inoperative range finder.
17. Focal plane closed.
18. Failure to pull slide.
19. Double exposure.
20. Improper turning of slide.
21. Improper focusing of camera.
22. Failure to set camera at proper infinity stop.
23. Improper loading of film (reversed).
24. Not loading slide in light tight room.

Film

25. Film type wrong.
26. Use of previously fogged film.

Developing

27. Over or under development.
28. Wrong type of developer.
29. Exhausted developer.
30. Contaminated developer.
31. Developing tank not light tight.
32. Wash water too hot.
33. Drying in unclean cabinet.
34. Drying too fast.
35. Heat of dryer too extreme.
36. Going into wrong solution in dark room (hypo first).

Prints

37. Out of focus.
38. Improper contrast (wrong paper).
39. Improper fixing (hypo).
40. Improper wash (over or under).
41. Dryer too hot.
42. Solutions contaminated.
43. Not enlarged to scale.
44. Failure to place identification on negative.

VI

FIREARMS IDENTIFICATION

THE TERM "ballistics" is commonly used to identify the work done by the firearms expert. It is a misnomer, and should not be used in police work. Ballistics comes from the Latin word *ballista*, which was used to designate an ancient military machine for hurling large missiles. Today it is more closely defined as the study of the motion of a projectile in flight.

Since there are many excellent works on the scientific techniques and procedures used by firearms identification experts, it is not the intention of the author to discuss the subject from a technical standpoint.

It is important, however, that the field investigator have some knowledge of the general characteristics and classifications of firearms, for this will aid him in his investigation. He should also know the limitations—in other words, what can and cannot be done by the firearms identification expert.

Most of the firearms involved in police cases are some form of hand guns.

These may be divided into two general classifications: the revolver and the automatic pistol. Both may be further divided or designated as (1) the "Smith & Wesson" type, which has five lands and grooves and a right hand twist, or (2) the "Colt" type, which has six lands and grooves and a left hand twist. This latter classification is now becoming less specific as numerous guns presently being confiscated vary both as to twist and land and groove count; especially is this true of 22 caliber firearms.

In an investigation time is essential, thus if the investigator can recognize the bullet involved in a specific case as to the possible type, make, and caliber of the gun, he may greatly speed his work.

Cartridges — Automatic Pistols and Revolvers

Genuine automatic pistol bullets are of the metal jacketed

type; usually this jacket consists of copper, brass, or nickled brass. Automatic cartridges can be fired in revolvers, but it is almost an impossibility to fire revolver cartridges from an automatic pistol. This is due to the difference of the rims on each. Automatic shells are referred to as rimless, because the rim is the same diameter as the rest of the casing. The rim on the revolver cartridge is considerably larger than the casing. Bullets from the revolver cartridge are generally composed of lead and are not jacketed. The above information, of course, is common knowledge to the old time investigator but the inexperienced officer may find it new.

The above classifications and descriptions hold true for American made revolvers and automatics only. Foreign made guns do not necessarily have these specifications. Spain has turned out a variety of types and makes, some of which are fairly good copies of American made guns. During a period of one and one-half years, thirty-five different makes of Spanish automatic pistols passed through the Los Angeles Police Laboratory, yet that is only about one-third of the total makes originating in that country. It was also noted that in many cases the same make of pistol might have either a left or right hand twist of the rifling and that guns of different caliber, yet of the same make, might also have a different twist of the rifling.

Germany ranks second in number of makes of automatic pistols.

Caliber

The caliber of a gun is designated according to the diameter in hundredths or thousandths of an inch or in millimeters and is measured from land to land. Guns may be found in many different calibers, 22, 25, 32, 38, 380, 41, and 45 caliber. The bore diameter of the barrel is also measured in hundredths, or thousandths of an inch or in millimeters. It should be noted that the caliber of the gun is not always exactly the same as the diameter of the barrel, nor is the diameter of the bullet used for any caliber of gun the same as the diameter of the barrel. It is needless to say that the bullet diameter must be greater than that of the barrel in order for the rifling to take effect.

Pitch

The pitch of the rifling refers to the number of inches a bullet must travel in the barrel of a gun in order to make one complete revolution.

Land and Groove

The relationship between the land and groove as shown in the following table is only approximate.

Make	*No. of Lands & Grooves*	*Pitch of Rifling*	*Twist of Rifling*	*Relation of Width of Lands to Grooves*
Colt	6	1 turn in 16 in.	Left	L ½ of G (approx.)
Smith & Wesson	5	1 turn in 18.75 in.	Right	L & G equal
Harrington & Richardson	6	1 turn in 12 in.	Right	L ¾ of G
Harrington & Richardson (Old Model)	5	1 turn in 12 in.	Right	L ¾ of G
Iver Johnson	5	1 turn in 23 in.	Right	Approx. same
Remington	7	1 turn in 16 in.	Right	L ½ of G
Savage	6	1 turn in 12 in.	Right	L ⅓ of G

Slippage

Slippage is caused by the bullet failing to make the same amount of rotation in the barrel as the rifling. The more worn the barrel the greater tendency for slippage. This may also result where a bullet is of a caliber slightly less than the gun in which it is fired. For example, firing a 380 cartridge in a 38 revolver.

Bore

The bore of a gun is the true diameter of the barrel as measured from the surface on one side to the surface on the other before the grooves are cut in the barrel.

Diameter of Bullets

Below is a list of the approximate diameters of various caliber bullets in inches:

1. 45 caliber 7/16"
2. 38 or 380 caliber 3/8"
3. 32 caliber 5/16"
4. 25 caliber 1/4"
5. 22 caliber 3/16"

Often, through impact, the bullet is too misshapen to allow

the diameter to be measured accurately. In such case, the weight may give some clue to its caliber.

Below are listed a number of common types of bullets and the approximate weight of each in grains. Remember that there are 437½ grains in one ounce avoirdupois.

Weights of Various Type Bullets

Caliber	*Approximate Weight*
22 long rifle	40 grains
25 automatic	50 grains
32 automatic	73 grains
32 Colt revolver	82 grains
32 Smith & Wesson revolver	85 grains
32 Colt long	82 grains
32 Colt MP	100 grains
32 Smith & Wesson	98 grains
32 Winchester center fire same as 32-20	100 grains
30 Luger	93 grains
32 Long Smith & Wesson	98 grains
35 Smith & Wesson Automatic	76 grains
380 Automatic	95 grains
38 Colt Revolver	125 grains
38 Automatic	130 grains
9 mm Luger	125 grains
38 Smith & Wesson revolver	146 grains
38 Colt new police	150 grains
38 Special	158 grains
38-40 Winchester Center Fire	180 grains
41 Colt Revolver	160 grains
41 Colt long	196 grains
44 Gamegetter	119 grains
44 Bulldog	168 grains
44 Webley	200 grains
44 Smith & Wesson American	205 grains
44-40 Winchester Center Fire	200 grains
44 Smith & Wesson—Russian	246 grains
44 Smith & Wesson Special	246 grains
45 Automatic	230 grains
45 Colt	255 grains

Although these weights do not exactly correspond to weights set forth by the various manufacturers, they were obtained by taking an average of the weights of these various types of bullets as they came through the laboratory during the course of regular police work. If the bullet has been badly distorted by striking

some solid object such as a wall, a sidewalk, or a rock, one must make allowance for possible loss through chipping.

Fired Cartridges

The identification of fired cartridges or shells is usually quite simple, as most of them have such information on their base. Again this is not always true with foreign make cartridges.

Where a lead bullet is found having no cannelure or grease ring and where there are no milling marks the investigator may conclude that it is a reload bullet. Manufactured bullets will have milling marks in the cannelure and will generally have bases that are concave to some degree. Modern reloads may also have cannelures.

Shotguns

Positive identification of a charge from a shotgun is generally impossible, yet much information as to the bore and type of shells may be gained through a study of the shot and the wadding, if such is found. The lead pellets may also be compared spectrographically with the pellets from shells found in the possession of a suspect. Pellets from the same batch of molten material will be spectrographically alike, while those from different batches will show considerable divergence. Shot, even in the same shell, are not always from the same batch of molten lead. It may be noted that wads removed from a dead body and saturated with body fluids will swell and appear to have come from a larger bore than they actually did.

Muzzle Distance

The distance the muzzle of a shotgun was from its target cannot always be measured accurately because of the difficulty of identifying the exact size of the pattern. Especially is this true of a charge from a sawed-off shotgun, the pattern of which is very erratic. If the victim is standing near a wall or a board fence, fair estimation of the pattern of a shotgun blast may be obtained.

The muzzle distance may be established through experimentation. If possible, the same gun, the same size of pellets, and the same type of ammunition should be used.

Where a handgun is held close enough to leave powder burns

or tattooing on the body of the victim, the muzzle distance may be established with a fair degree of accuracy. This information is often of great importance in establishing whether the case was suicide or murder. Again this distance must be determined through experimentation, the original conditions being simulated as nearly as possible by using the gun involved and the same type of ammunition. The following is a very satisfactory procedure: sheets of white blotting paper, about 18" square, should be soaked in water and the excess water allowed to drain off; these blotters should be fastened vertically to the face of a recovery box, and then the test shots fired at various measured distances, starting with a contact shot and moving back by inches until all various size patterns are established. Of course, each shot must be fired into a clean sheet of blotting paper. Each sheet must be labeled as to muzzle distance, type of ammunition, date, case number, and the investigator's initials.

A comparison between these experimental patterns and the pattern found on the body will permit the expert to arrive at a fairly accurate conclusion concerning the distance the muzzle of the gun was held from the victim.

When a bullet passes through clothing before entering the body the powder burns or tattooing is not visible; there may exist a nitrite pattern which can be developed through the Walker Nitrite test.

Preparation for Test

A sheet of unexposed glossy photographic paper about sixteen inches square is immersed in freshly made hypo-solution until all the silver salts are removed. It should take between fifteen and twenty minutes. The paper is then washed for an hour in running water. It is then immersed in a five to ten per cent aqueous solution of "C" acid (2-Naphthylamine-4, 8- disulphonic acid). There is a modification of the process using "H" acid (1-Ammo-8-Naphthol-3, 6-disulfonic acid). The latter method does not necessitate the desensitizing and washing of the paper.

Procedure

1. A clean white bath towel is placed on a work table.

2. The above prepared photographic paper is placed face up on the towel.
3. The fabric to be tested is placed face down on paper.
4. A dry towel is then placed over the fabric.
5. A towel, moistened in a five to ten per cent solution of acetic acid, is next placed as the fifth layer.
6. The sixth layer is a dry towel. These series of layers are then pressed with a warm iron for ten to fifteen minutes.

In place of the iron, a mounting press works admirably. It gives a uniform distribution of heat. If the face of the fabric was impregnated with nitrites they will be transfered to the test paper and will show up as small red-orange spots. The extent of the pattern may thus be determined.

Through this method it is possible to establish the muzzle distance of a hand gun up to forty inches and with a rifle up to seventy-two inches. In an actual case using a magnum with super ammunition it left a discernible pattern at nine feet. This of course is unusual.

Test Shots from Firearms

The objective of a recovery box is to enable the expert to recover the spent bullet in the best possible condition. In other words the best procedure is that procedure which has the least tendency to alter the surface of the bullet. Various methods have been used in the Los Angeles Crime Laboratory and their advantages and disadvantages will be set forth separately.

Water Method

Bullets may be fired with excellent results into a vertical barrel containing water. While there will be no change on the rifle markings through this method, there are a number of disadvantages: (1) If the gun is not held perpendicular to the surface of the water there is a possibility that the bullet may ricochet. (2) It necessitates some method of going to the bottom of the barrel to recover the bullet. (3) When muzzle velocity exceeds 1000 feet per second, bullets may be distorted. (4) It does not lend itself well to establishing muzzle distance. The first three disadvantages have been overcome by using a ten foot tank, eighteen inches in diameter, and filled with water. A recovery

basket in the bottom is raised by air pressure. To establish muzzle distance, a cotton waste recovery box is preferable.

Soap Method

Firing a bullet into a container packed with soap is also an excellent recovery means. The main disadvantage with this procedure is that the bullet will not follow a true course and at times may change its direction and pass out through, or at least come in contact with, the side of the container.

Cotton Waste Method

This method consists of firing the bullet into a box tightly packed with cotton waste. The box should be approximately four feet long and eighteen inches square, and should be filled with cotton waste throughout its entire length. A piece of one-fourth inch sheet iron should be placed as a back stop in the extreme end to prevent a bullet having a greater velocity than anticipated from passing through the end of box. The waste should be separated with sheets of white paper at eight inch intervals. The spent bullet may then be located by noting the number of sheets of paper it has passed through, and then by searching that section containing the projectile. Generally the bullet will be stopped in the first twelve to eighteen inches. This procedure has most of the advantages of the water recovery method and is far easier to operate. The author has made a close comparison between bullets recovered through this method and those through the use of the water method and he has found no noticeable differences in their surface characteristics except on soft leaded bullets such as a 22. However, he has found that a specially built water tank with a recovery mechanism and with built-in safety factors more than pays for itself in time saved in searching for the bullet. The number of tests made per month would be a determining factor in making the decision between a tank and a box.

Recovery of Rifle Bullets

Recovery of a rifle bullet requires a much longer box, possibly as long as six to eight feet. Where such a box is not available the one mentioned above may be used. Before firing the cartridge, the bullet should be carefully extracted by hand,

and about 2/3 of the powder removed, the bullet then replaced in the shell. This procedure will cause the bullet to travel a lesser distance, yet most of the rifle markings will be retained intact. If the barrel of the rifle is badly worn there may be some discrepancy in the pattern, and a box of sufficient length to recover a fully charged bullet should be used; otherwise, there may be a difference due to slippage.

Recovery of Bullets at the Scene

When it is necessary for the investigator to recover a bullet which is embedded in wood or plaster he should take great care to insure that the rifle markings or striations are not injured. Tools such as pry bars or pliers should never, under any consideration, come in contact with the bullet. Pellets recovered from the above types of materials are generally distorted and many of their identifiable characteristics are destroyed. Therefore it is highly important that the little that does remain be preserved. The investigator may carefully open a hole around the bullet and then work it loose with his fingers. If a bullet is deeply embedded in a piece of wood it may be possible to saw out a portion of the wood and ship it intact to the laboratory for removal under more favorable conditions. Sometimes it may be necessary to locate bullets deeply embedded in walls, or in overstuffed furniture, and when found are some distance from the entrance hole. A portable X-ray is excellent for this purpose, as it will permit the investigator to locate the object without unnecessarily destroying property.

Live Ammunition

When live ammunition is found in connection with any case it should be booked and then submitted to the laboratory for analysis.

If such ammunition has previously been loaded into an automatic pistol and then ejected, there are the possibilities that extractor or ejector marks could be present. These may be identified with the gun in question or with ejected shells found at the scene.

Occasionally the hammer is inadventently released with such force as to leave an indentation in the primer, yet with not

enough force to detonate it. This firing pin mark, even though slight, may be identifiable.

The sequence of shells or live ammunition in the revolver cylinder may also be important and, if possible, should not be changed before the gun is submitted to the laboratory. If it does become necessary to remove them, they should be marked in such a way as to identify each with the chamber from which it came.

Dermal Nitrate or Paraffine Test

The so-called paraffine test should never be used. It does not aid in proving a case, and is worthless from an investigative standpoint. To cite some of the reasons for this allegation: (1) Not all guns have a tendency to throw powder onto the hand that fires them. In laboratory tests it was found that only one gun of eighteen definitely left an identifiable pattern. (2) Many substances besides powder give a positive reaction with the diphenylamine sulphuric acid reagent. The reaction only identifies

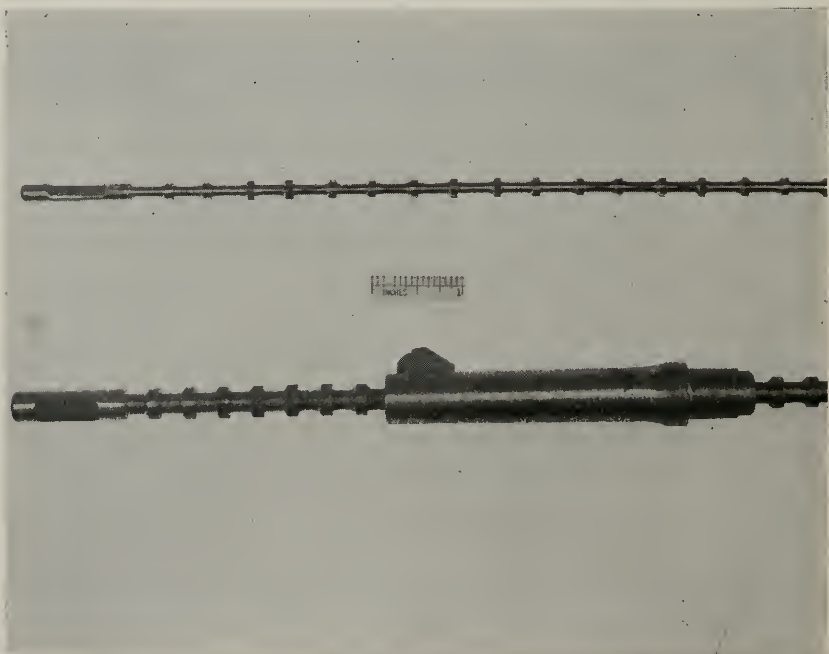


Figure 41. Step Broaches: One method of cutting grooves in barrel of a gun.

a nitrate, and there are many substances containing nitrates—cigarette or cigar ashes, washing powders, fertilizers, or even soil. (3) A defense attorney has a tendency to take the results of such a test, if negative, as a definite proof that his client did not fire the gun, although the mere fact that the gun did not throw powder may be the real cause why no reaction was obtained. Even if the hand is found to give a positive reaction to the test, how is one to know whether or not the reaction is the result of powder residue? The author has generally found that when a specific type of test is inconclusive or indefinite it is better to refrain from using the test.

When powder burns are found on the body or clothing of the victim or when small particles of suspected powder residue are found, the di-phenylamine sulphuric acid may aid in identifying these substances.

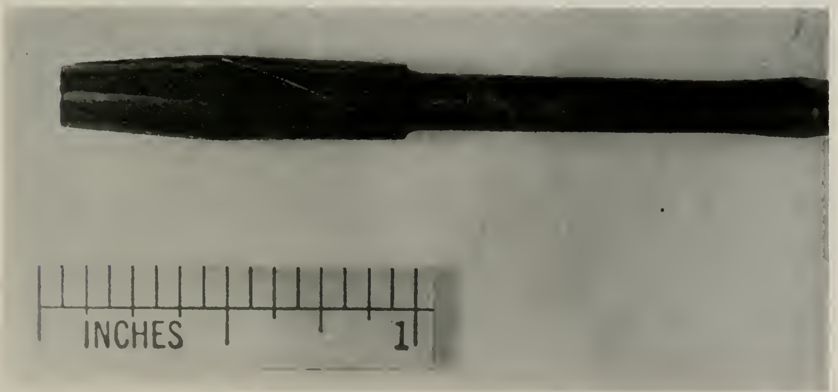


Figure 42. Button Broach: Another method used for cutting grooves in barrel.

Photography in Firearms Identification

It is the responsibility of the investigator to see that any powder-burns entrance or exit wounds are photographed. Sometimes it is found that the holes through the clothing do not match, thus showing disarrangement at the time of the shot—this should be photographed. If the investigator feels that color or three dimensional photography will help him to present his case in court, then he should call for it. If the surgeon can probe the wound, this should be photographed. All bruises, cuts,

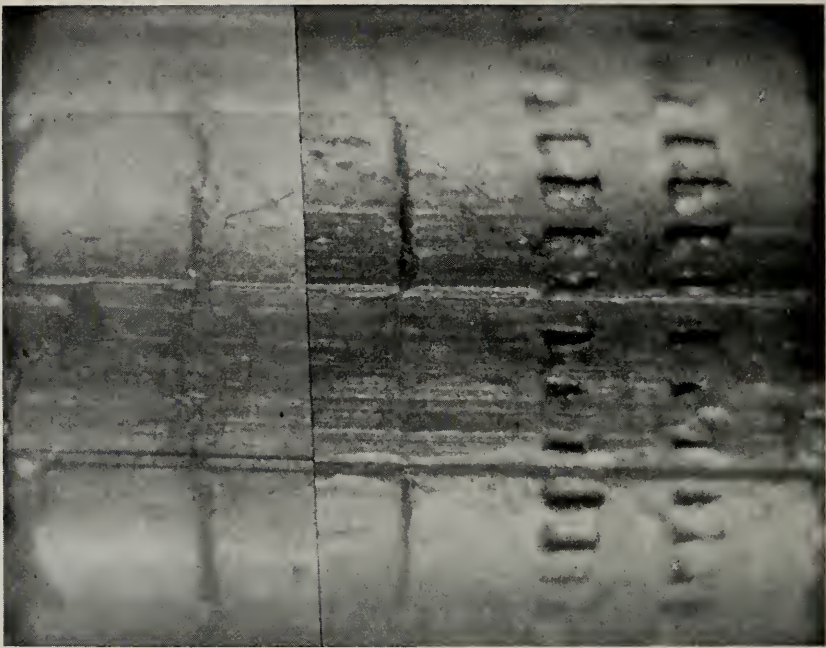


Figure 43. Bullets from two consecutive Hi Standard barrels. Barrels were cut from twenty-four inch stock and the same button broach was used in each. Although there are family characteristics, the fine lines do not match.

scratches, abrasions, or any other condition that the investigator feels may be important should be photographed. Remember, once the body is posted, and has left the premises, such photography may be impossible.

Zip Guns

All types of home-made guns are generally referred to as zip guns, the most common of which is made from the tube-type radio antenna of an automobile. Even though these may appear harmless, they can still be deadly. An unusual one, recovered in Los Angeles, had a flint lock mechanism and a bore to accommodate a bb shot. A seventeen year old boy was using this with great accuracy.

Explosives

Explosives may be divided into two classifications—low and high velocity powders. The most common of the low velocity

type is black powder. Most nitrates such as dynamite, nitroglycerin, et cetera, are high velocity powders.

A low velocity powder has a tendency to push or shove and must be contained in order to get an effect. The high velocity powder shatters and does not have to be contained. Most homemade bombs use a low velocity powder and are generally in some type of a container, such as a piece of pipe which has a cap on each end, a heavily wrapped paper container, or even tin cans, and are ignited by a powder fuse.

They may resemble a large firecracker. This type of bomb is safe if the fuse is not burning or if the investigator does not try to disassemble it. The rubbing of pieces of metal together may ignite the powder.

High velocity powder may be ignited by a percussion cap, severe jarring, or by heat, thus an investigator should never try to disassemble any bomb that is thought to contain this type of an explosive. A high velocity bomb may be rigged so as to detonate when it is tilted or through the use of a time clock. It also may be assembled in such a manner that it will explode if the string around the box is severed or if the mechanism is emersed in water. Many ingenious bombs have been built using high velocity powder. The best advice to the investigator is to clear the area and send for an explosives expert, unless of course he is one himself. Even the expert should fluoroscope a bomb before proceeding to take it apart.

The author has helped disassemble two very unusual bombs. Number one was a quart size thermos bottle in which two sticks of dynamite were tightly packed. The detonating mechanism consisted of an electric detonator cap, copper wire, two flashlight batteries, and a test tube half full of mercury. The ends of two wires were held in place in the upper half of the test tube in such a manner that if the container were tipped over or tilted an electric circuit would be completed. Number two consisted of a box six inches by six inches by eight inches. This package had been received through the U. S. mail. Examination of the container disclosed that the string around the box was under tension and that one end of it passed through a hole in the box beneath the knot. The box was entered through the side and was found to contain the following mechanism: The container was divided

into two compartments which were separated by means of a piece of tissue paper. The one half contained flash powder; in the other half was a set mouse trap to which was attached a book of matches constructed in such a way that to cut the string around the box would release the trap, ignite the matches, and thus ignite the flash powder.

When an investigator is called to the scene of an explosion, it is important to be able to recognize the agent that has caused the damage. Black powder, natural gas, or other slow burning substances will shove walls, cave in doors, et cetera. They will not splinter as will a high velocity powder. It is also true that a low velocity substance has a greater tendency to start a fire than does the high velocity explosive.

VII

QUESTIONED DOCUMENT EXAMINATION

The specialist or expert in the field of document examination is frequently referred to as the "handwriting expert." This title is a misnomer. Examination of documents may entail comparison of handwriting, handprinting, typewriting, printing, inks, erasures, papers, et cetera. Thus the title "examiner of questioned documents" more accurately describes his work.

The examination of questioned documents requires certain preliminary work by the investigator before the expert can reach definite conclusions.

The expert's opinion is based upon the similarities or differences between the admittedly genuine standard and the questioned document. Examinations of this type consist for the most part of a side by side comparison—comparing the questioned evidence with known standards, either macroscopically, microscopically, or both. It therefore becomes the investigator's task to furnish the expert with undisputed specimens of handwriting, typewriting, and so on. Unfortunately investigators often fail to or cannot submit sufficient material for comparison. It is also true that at times examiners of documents have been tempted to express an opinion based upon insufficient standards.

The standards for comparison must be admissible as evidence. They must be proven as genuine to the satisfaction of the court. Under the statute enacted in 1880 (New York) and amended in 1888, any document or writing may be introduced as evidence and may be used as a standard of comparison even if it is not connected in any way with the case. The standard will be accepted if the court is satisfied that such writing is genuine.

A standard of comparison is defined as a specimen of handwriting, printing, or typewriting whose origin can be definitely established in one of the following ways:

1. By one who actually witnessed the writing of the document.
2. By one who, though not present but through close per-

sonal contact, has observed the individual writing frequently, and who thereby can recognize and identify the writing as having been written by that certain individual.

3. By one who has heard an individual admit that a certain writing is in his hand.

Number two is the least satisfactory of the three methods of proof.

The detective is primarily interested in:

1. What can be done to aid him in a specific case.
2. What type of exemplars should be obtained by him to insure an accurate analysis.
3. How and where he may obtain these exemplars.

The questioned document expert may be able to aid investigator in the following ways:

1. By establishing that the paper is of the same specific weight, make, and composition.
2. By identifying the type of ink, lead, or crayon.
3. By bringing out obliterated or eradicated writing.
4. By establishing the approximate age of the document.
5. By developing and identifying indented writing.
6. By bringing out possible writing on used carbon paper.
7. By reconstructing charred letters or notes.
8. By establishing the type of pen, pencil, et cetera.
9. By comparing questioned writing with known exemplars to establish genuiness or forgery.
10. By examining typewriting and by identifying the make and age of the typewriter used.
11. By examining perforations around stamps, checks, et cetera, in order to connect them with the portion from which they were torn.

Far too often the questioned document expert's services are thought of as being necessary only where a document is suspected of having been forged, when, as a matter of fact, he may aid in the solution of many other types of cases.

Notations in a memorandum book, handwriting on an automobile owner certificate, an ink offset on a blotter, a piece of paper found at the scene of a crime, or a host of other documents which at first may appear to be of little consequence may later prove to be the most important evidence in a case.

A scrap of paper found in the watch pocket of an unidentified murder victim, overlooked in two previous searches made of his clothing, established his identity and led to the apprehension and conviction of the murderer.

A blotter found in the home of a murder suspect bore an ink offset from a woman's signature which had been forged to an assignment of stock. The motive for her murder was to obtain this valuable stock (a well known public utility). The forger blotted the forged signature and kept the blotter in his desk for several months. It was found during the investigation of the case, and it proved to be highly incriminating evidence.

A paper tablet found in the room of a kidnap suspect contained on the first sheet indentations which corresponded exactly with an extortion letter demanding ransom money. The indentations on the tablet were at first overlooked, but when they were discovered they became important evidence.

Because of the increased use of the typewriter, numerous identification questions arise concerning typewritten documents. Through use and misuse the type of an instrument becomes defective, making it possible to identify typewriting as having been written on a particular machine.

Some spurious documents may have unwittingly been given a date which was prior to the time the paper itself was manufactured, as established by the water mark, or it may be shown that certain constituents of the paper were not used as paper making materials at the alleged date.

The sequence of two crossed lines may determine whether or not a fraudulent addition has been made to the document.

An erased area on a document may contain valuable evidence that can be made readable through the use of ultra violet light, by infra red photography, or by some means used in deciphering obliterated writings.

In searching for facts nothing should be overlooked, and all documents which are likely to become of evidential value should be handled with extreme care and should be protected from any alteration, careless or otherwise, to their physical condition.

The best standards of comparison are those of the same general class as the questioned writing. They should correspond to the questioned article in physical characteristics; if the ques-

tioned writing is in ink, written on ruled, lined, or good quality white bond paper, then an effort should be made to secure exemplars for comparison which are also written in ink on paper of a similar quality, and, if possible, the same color. The color of the paper and ink is less important than the other items. If a questioned signature was written in pencil on rough paper, then the best standard would be a genuine signature also written in pencil on similar paper.

The use of yellow paper should be avoided whenever possible, owing to photographic reproduction difficulties.

The securing of requested writing is more involved than the mere act of supplying a suspect with paper and pen and requesting that he write a few words or lines. The genuine handwriting standards may usually be obtained without difficulty, as the person who claims the document to be forged as a rule will not hesitate to write anything required of him.

Standards of writing for comparison should include not only those made by the suspect, but also samples from all others who may have had an opportunity to write the questioned documents.

In obtaining request writings from a suspect, the investigator should expect an attempt will be made to disguise writing characteristics. It is unwise to show the suspect the questioned document before requesting samples of his writing. As has been pointed out before, efforts should be made to have pen, ink, and paper, or pencil and paper, as the case may be, which approximate those used in making the questioned signature.

It is suggested that the subject be permitted to write a series of papers, that his writing be interrupted from time to time, and that he be given a fresh sheet of paper each time. He should also be requested to write the same or similar material as contained in the document. This is preferable to having a suspect write a long column of signatures, or to keeping the request writing on one sheet of paper, for supplying him with new paper gives him less opportunity to disguise his writing.

If the questioned document involves a signature, the suspect should first be asked to write a different signature which includes identical combinations of letters. For example, if the suspected signature is William Anderson, he should be requested to write Andrew Wilson.

If the questioned signature or writing was limited by lines on ruled paper, then an effort should be made to have the requested writing on ruled paper. Some persons change the size and spacing of their writing to avoid touching printed lines, while others ignore the lines completely and write over them.

If the investigator has any knowledge as to the position the forger was in at the time he did the writing—standing, sitting, or lying down—the suspect should be requested to make exemplars in a similar position.

Specimens of the suspect's handwriting should be obtained as soon after arrest as possible. A delay may give him time to see his lawyer, or talk to other prisoners, and after so doing he may refuse to give a specimen or, if he does write, he may disguise it in such a way as to make identity through comparison difficult, if not impossible.

Standard writings used as exemplars should be as near the same date as the alleged forgeries if it is possible to obtain them. It is also good procedure to obtain some standards written prior and subsequent to the alleged forgery.

Requested writing from a suspect should include, if possible:

1. Alphabet—capital letters
2. Alphabet—small letters
3. A group of figures from one to ten, inclusive

It is often important to have the suspect write at different sittings, or better still, on different days. Such a procedure will bring out natural variations in his writing.

In submitting documentary evidence to the questioned document expert, the detective should supply him with the facts of the case. These facts should include the source of the document, the circumstances under which it was found, and, as previously outlined, standards of comparison from the suspected person, or any others who may be involved.

It may be difficult at times to get standards of writing for comparison. The suspected writer of the document may refuse to give a sample of his handwriting, or he may be deceased, or insane, or otherwise unable to do so. Also, he may disguise his handwriting to such an extent that it becomes worthless as a standard.

Listed below are suggested lines of inquiry by which standards of handwriting may be located:

administrator
architectural plans
armed services
auctions
autograph album
automobile contract
bail bonding companies
bank accounts
bankruptcy proceedings
bank safe deposits
book contract
business associates
certificate of baptism
chattel mortgages
Civil Service (municipal, state and federal)
clubs and lodges
colleges
complaint bureaus (city departments and district attorney)
copyrights
courts (criminal and civil)
credit slips
criminal records
customs houses
death certificates
departments of identification
departments of correction
drivers license
electric light contract
employment bureaus
executor of estates
furniture contract
gas contract
income tax agent
incorporation papers
installment contract
institutions (hospital, asylum)
insurance
janitors
jury records
leases
legal papers
letters and postal cards to friends
loan companies
marriage license
medical clinics
members of the family
messenger boy receipts
military records
National Guard
naturalization
neighboring businesses
newspaper men
notaries
notes to tradesmen
office boys
order blanks
passports
patents
piano contract
political organizations
prescriptions
prison records
railroad passes
real estate offices
receipt books
receipted bills
receipt for pay
receiver
records (Labor Union)
rental agencies
reports
schools
secretary
shipping agencies
signee
social security
societies and fraternities
steamship tickets
stenographer
stock exchange
suspect's home
suspect's office
tax departments—municipal, state, and federal
telegraph companies
telephone contracts
time cards
title guarantee companies
trustees or guardians
unemployment insurance
U. S. post office
valentines
voting records

Protection of Evidence

1. Checks, documents, and all paper evidence should be photographed or photostated before being submitted to the latent fingerprint division for examination.

2. All questioned documents should be placed separately in cellophane envelopes as soon as they are received. This will prevent smudging, creasing, or defacing the document. If there is a possibility of finding fingerprints which would be important, the document should be placed in the cellophane envelope with a pair of tweezers. This will prevent extraneous prints from being found on the evidence. Evidence encased in a cellophane envelope is visible on both sides, yet is protected during examination.

3. It is a bad procedure to place marks of identification on a document which is to be used as evidence. It should never be touched with a pencil, pen, or any sharp instrument. To underscore or encircle words is amateurish and should never be done. Alterations of this type may exclude the document as evidence. If there is any question as to being able to identify the document at some later date, it should be photographed, and the photograph retained in the investigator's possession. Any unauthorized mark placed on a document prior to its submission in court gives the defense attorney an additional point for argument.

4. A document should never be folded, creased, torn or discolored.

5. Before submitting a document to the latent fingerprint section it is well to realize the possible effect on that document. Chemicals may eradicate ink writing, or fingerprint powder may deface the document to such an extent that its evidential value is weakened. If the paper is of such a type as to retain fingerprints, and if such prints would far outweigh the writing as evidence, then the procedure may be justified. Each case must stand on its own merits. Remember, one *may* find fingerprints but one *has* the writing.

6. Documents should be kept away from excessive heat and strong light, and should not be submitted for any chemical test (or other types of tests) except to a qualified expert.

7. The document should be submitted to the questioned

document expert as soon as possible after it has come into the investigator's possession. If it is to be forwarded by mail it should be encased in a cellophane envelope, protected on both sides by stiff cardboard, and sent first class, registered mail, with a return receipt requested. This will protect the chain of continuity of the evidence. The chain of continuity must be complete from the time the document is found until it is introduced as evidence in a legal proceeding.

Anonymous Letters

Anonymous letters should be photographed immediately, enclosed in cellophane envelopes, and then submitted to a laboratory for fingerprint tests. Comparison writings as standards in anonymous letter cases should contain many of the original words, numerals, question marks, or designs. Again, the writing should be made under conditions as identical as those found in the evidence, if it is possible to do so. The request writing should also include the recipient of the anonymous letter, as it is commonly known that anonymous letter writers frequently include themselves. At the same time, the investigator should make careful analysis of the contents of the letter. Frequently some incident mentioned in an anonymous letter may be known only to certain individuals. This would decrease the field of possibilities. Also, it is sometimes possible to determine the author of a document by "internal style"; although it is doubtful that such evidence would stand in court, it may give the investigator a "lead."

Typewritten Documents

In matters involving typewriting, the procedure for obtaining exemplars is somewhat different from that of handwriting. If the identification of a particular typewriter is involved, specimens from all possible typewriters of the same make and model should be secured for comparison. Numerous exemplars should be made on each typewriter, varying the pressure on the keys. Certain type characteristics will show up when the typist has a heavy touch that will not be apparent if the typist uses a light touch, and vice versa. If the original document is several years old, samples of comparison which are about the same age should be obtained. Typewriters change their characteristics with age

and use. The investigator should be certain the exemplars contain the same words as those which appear in the questioned documents.

VIII

BLOOD ALCOHOL

WINE IS probably the earliest intoxicating beverage, dating back to the prehistoric era, some ten to twelve thousand years ago. The earliest record of beer brewing is 2,225 B.C. Distillation of alcohol is thought to have originated in India; it was known in Persia a little before 500 B.C. By the fifth century B.C., drunkenness had become a medical matter.

Many civilizations of the past have attempted either to prohibit or to control alcohol, but without success. Attempts were made at various times in China, in India, in Mesopotamia—even among the Aztecs and the Incas—to establish some system of protecting man from his weakness for alcohol. The Hindus went so far as to make the manufacture, trade, sale, barter, or use of alcoholic beverages a capital offense, but man still drank.

The first law in modern English history against drunkenness was enacted in 1606. The fine was five shillings, or, if the defendant was unable to pay, six hours in the stocks. The intent of the confinement was to keep the offender from doing mischief to his neighbors while he sobered up.

Since then, many types of restrictions and penalties have been enforced and none of them has been entirely successful. The custom of imbibing alcoholic beverages has prevailed in spite of laws forbidding or restricting it. In our modern era, the drunk behind the steering wheel of an automobile is the instrument of appalling property damage, injury, mutilation, and death.

The Need for Chemical Tests

Generally, the *corpus delecti* of a drunk driving statute is the driving of a motor vehicle upon the public highways while under the influence of an alcoholic beverage. If a chemical test is not used, the establishment of the suspect's intoxication depends upon the accurate judgment and experience of the arresting officer. Later, in court, the officer may find it difficult to convince a

judge or jury that his observations were competent. A test to determine the concentration of alcohol in the blood of a suspect at the time of the arrest further substantiates the evidence against the suspect.

Other considerations in determining the need for a chemical test program are:

1. Protection of those persons who are suffering from some disease or injury, the symptoms of which could resemble those of alcoholic intoxication.
2. The releasing of innocent persons without unnecessary embarrassment or inconvenience.

Through the use of a chemical test it is possible to prevent intoxication being used as a defense by a suspect charged with a serious crime. Generally, the commission of a crime while intoxicated is no defense, but there is often a tendency on the part of juries to consider it so.

The Choice of a Chemical Test

Chemical tests to aid in the diagnosis of inebriation are not new. The first such tests were proposed about forty-four years ago. As early as 1903, a French scientist showed that a definite relationship exists between the amount of alcohol in the blood and its toxic manifestations.

The different tests may be grouped according to the samples they require. Basically, there are two types of chemical tests, those using body fluids and those using breath. The body fluids which may be used are blood, urine, saliva, and spinal fluid. In addition to body fluids, brain tissue may be used for autopsy examination.

All tests are concerned with determining the concentration of alcohol in the brain tissue of the suspect at the time the sample was taken. Blood, breath, and saliva are almost equally accurate, while urine and spinal fluid are the least accurate. Urine will give only the average of the concentration of alcohol that was in the blood between the time the bladder was last emptied and the time the sample was collected. Spinal fluid may be used for detecting the presence of alcohol when the taking of a test sample must be delayed for any reason. Alcohol has been found in the spinal fluid as late as ten days after alcohol has been injested.

However, under normal circumstances, a test for autopsy purposes is usually performed upon blood taken from the femoral artery.

All chemical tests have points in common, or, at least, points in common within their own groups. The results of tests are reported in per cent by weight of alcohol (usually in milligrams) in a given volume of blood. All tests are performed upon a small amount of specimen. The results of tests which use samples other than blood are "translated" to correspond with the results of tests using blood. Body fluids used in tests are distilled at least once and either a colorimetric comparison or a titration is used to determine the results.

Tests on Body Fluids

It would appear that there are almost as many methods of determining the alcoholic concentration in fluid samples as there are chemists working in this field. The Kozelka-Hine method, however, is one of the most reliable and is perhaps the best known.

The Kozelka-Hine method for the determination of ethyl alcohol in blood is as follows:

> Basically a one to two cc. sample of whole blood is double steam distilled. Steam from the generator is passed through the blood sample to which has been added 5 cc. of 10 per cent sodium tungstate and 5 cc. of 1 N sulfuric acid to precipitate the protein. Vapor from this step is then passed through a solution of 10 cc. of saturated sodium hydroxide and 10 cc. of saturated mercuric chloride solution to remove the acids, aldehydes, acetone, and phenols. Vapor from this second step is directly distilled into the digestion flask. After 25 to 30 cc. are distilled, 10 cc. of 0.1 N potassium dichromate solution (4.903 grams potassium dichromate per liter of distilled water) and 5 cc. of concentrated sulfuric acid are added to the distillate. The digestion flask is then capped and secured with the cap springs and then mixed. The digestion flask is then placed in a boiling water bath for twenty minutes, cooled to below room temperature, diluted with approximately 50 cc. distilled water, and approximately 0.2 grams potassium iodide is added. The excess dichromate is determined by the titration of the liberated iodine with standardized 0.1 N sodium thiosulfate (25 grams sodium thiosulfate plus 0.1 gram sodium

bicarbonate per liter). Five drops of 1 percent arrowroot starch solution is added when the iodine color is nearly removed and the titration completed. 1 cc. of the 0.1N dichromate solution is equivalent to 1.15 milligrams of ethyl alcohol.

After digestion and before the addition of the potassium iodide a colorimetric determination may be used instead of a

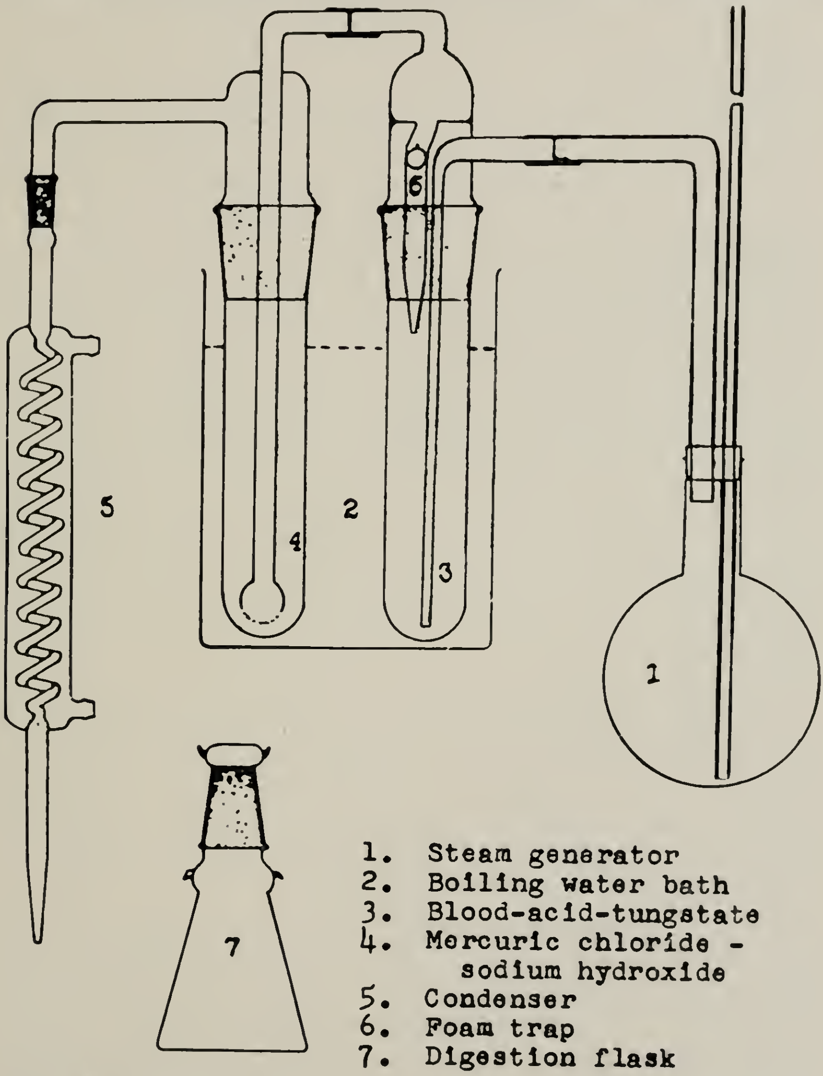


Figure 44. Schematic set-up for Kozelka-Hine method of blood alcohol analysis.

titration. The concentration of alcohol is determined by measuring the amount of potassium bichromate in solution in sulphuric acid which is reduced by the alcohol present, the reaction being:

$$3C_2H_5OH + 2K_2Cr_2O_7 + 8H_2SO_4 \longrightarrow 3CH_3COOH + 2K_2SO_4 + 2Cr_2(SO_4)_3 + 11H_2O$$

In titration with sodium thiosulfate the reactions are:

$$K_2Cr_2O_7 + 6KI + 7H_2SO_4 \longrightarrow 6I + 4K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O$$

$$6I + 6Na_2S_2O_3 \longrightarrow 6NaI + 3Na_2S_4O_6$$

Tests on Breath

As early as 1910, experiments indicated that breath could be used to determine the concentration of alcohol in the blood. What may well be the first breath test administered to a suspect by a law enforcement body took place in England in December, 1927. In addition to the usual objective tests for intoxication, the police surgeon asked the suspect to inflate a football bladder with his breath. The surgeon testified that his analysis showed the man was "fifty per cent drunk."

The first scientist to propose breath alcohol analysis for medicolegal purposes was Bogen, who published his method in 1927. Harger, Lamb, and Hulpieu published their method in 1938 and introduced the first breath instrument, the "Drunkometer." Greenberg and Keator introduced the "Alcometer" in 1941. Jetter, Moore, and Forrester published, in 1941, an article describing their "Intoximeter" method, but did not place the instrument on the market until 1949. Borkenstein introduced his "Breathalizer" in 1955.

In 1952, a special sub-committee of the Committee on Tests for Intoxication of the National Safety Council reported that the Alcometer, the Intoximeter, and the Drunkometer, if operated in the manner prescribed by the authors of the respective methods, gave "comparable and reliable results for estimating the concentration of alcohol in the blood."

The physiological basis of breath tests is the close relationship of the concentrations of alcohol and carbon dioxide in the deep lung air (alveolar air) and in whole blood. It has been determined that two liters of alveolar air will have the same amount of alcohol as will one cubic centimeter of blood, and that the same two liters of alveolar air will contain 200 milligrams of carbon dioxide. This is computed on the basis of a normal con-

centration of five and one-half per cent carbon dioxide in the alveolar air.

Selection among the breath test methods is dependent upon several factors. The various breath tests range from full portability, requiring no power source, to non-portability, requiring a power source of 110 volts alternating current. Only one does not require technical and mechanical knowledge on the part of the operator. Some require laboratory analysis by a chemist and some do not. In any event, it is necessary to have a technical expert available to explain the meaning of blood alcohol concentrations to the judge or jury in the cases which go to trial.

Significance of Blood Alcohol Concentrations

The doubtful range is from 0.05% to 0.15% blood alcohol. In this range, if there are objective symptoms of alcohol influence present, the suspect is under the influence; if there are no symptoms present, he is not. In the range from 0.15% to 0.25%, the suspect is definitely under the influence of alcohol. From 0.25% to approximately 0.33% the suspect is intoxicated: above 0.33% he is stuporous, and death occurs at approximately 0.5% blood alcohol.

IX

HIT AND RUN AND NEGLIGENT HOMICIDE

PROBABLY in no other type of investigation is the detective more dependent upon physical evidence than in hit and run cases. The act is accomplished in such a short period of time that frequently eyewitnesses, if there are such, are unable to give a description of the driver, license number, and often do not even remember the color or make of car. Many cases occur at night, and although witnesses may be present, they usually are able to see little. It is generally through systematic investigation and the gathering of physical evidence that it is possible to bring the perpetrator to justice.

The investigator has another problem which differs from the pattern of other types of investigation in that the perpetrator, in reality, is not of the criminal type. He may have run from the accident scene only because he panicked. Furthermore, he may be a substantial business man with many influential friends, and he may be financially able to avail himself of the best legal talent. His friends and family may conscientiously believe his story when he states that he did not strike anyone and they thus may throw many obstacles in the way of the investigating detective.

Solving a hit and run case involves a great deal of leg work, or plain, everyday systematic investigation, plus the ability to recognize every piece of physical evidence that may aid in the search. As in other types of crimes, the investigator has two sources of physical evidence; (1) that which is left at the scene, and (2) evidence which is carried away.

Primarily the investigator is interested in the first as a means of identifying the hit and run vehicle. At the least, the evidence may give some lead by which it may be possible to track down the car. Such evidence as broken glass, broken parts of the car, articles of clothing (for instance, a hat or a glove), tire tracks, chips of paint, or pieces of dirt that have fallen from the undercarriage may aid in establishing make, color, or even identity of

the car, and with this information it is possible in most cases to trace the driver.

During an investigation many cars may be examined; it then becomes necessary to use the second type of physical evidence in order to discover the car which was involved in the accident. Evidence found on the hit and run car may consist of fabric marks, parts of clothing, fibres, blood, skin tissue, hair, stains by articles carried by the victim, significant type indentations, and so on.

The Preliminary Investigator

The preliminary investigator at the scene of a hit and run has many responsibilities. It is he who is responsible for gathering and preserving physical evidence, interviewing and getting the names of witnesses, if any are present, protecting the victim until the ambulance or coroner arrives and preventing further accidents which might occur because of the hazard created by the first.

He should also make and catalog in his notes accurate measurements of all important details. Such measurements should include both length of skid marks and their relative positions to other objects on the street. There should be a complete interlacing of measurements, so that if, at some later date, the officer is asked the distance between various objects, he will have the information in his notes. Even though a survey and map are later made for use in court, the information contained in the officer's notes will still serve as very convincing testimony.

Photographing the Scene

A photographer should be called to the scene immediately and, if possible, photographs should be taken before the victim is removed. (Many preliminary investigators do their own photography.) Photographs taken at this time will show the relative position of the victim with respect to such objects as car lines, safety zones, cross walks, intersections, street lights, skid marks, et cetera. Whether the victim is present or not the whole scene should be thoroughly photographed, keeping in mind the various markers which may be of value later. If a witness states that he was standing at some specific place at the time of the impact a photograph should be taken from this exact spot. Such a photo-

graph may show whether the witness was able to see that which he states he saw, and may add credence to his testimony. Often the location of some specific object on the street—a glove, a piece of glass, or head light rim—may be of vital importance. In other words, this may establish the exact location of the victim at the time of impact. Photographs of these objects should be taken first at a distance to show their position relative to the entire scene, then from a closeup position to show the objects themselves.

Broken Headlight Glass

Prior to 1939, headlight glass was of the greatest importance, as often through measurements, curvature, manufacturer's name and numbers, it was possible to identify the make and model of the specific car involved. Since that date, however, automobile manufacturers have replaced the numerous lens types and styles with sealed beam headlights. Sealed beams are made for all makes of cars by only a few manufacturers, making headlight glass more or less standardized. However, all headlight glass at the scene should be picked up, even though it may entail searching the street for a block or more. Sometimes the location in which glass is found will establish the direction the car took after leaving the scene; in other words, it turned right or left at an intersection in the vicinity. The string of scattered glass may show that the car first drove to the curb after the impact and then proceeded on. This information will establish knowledge on the part of the driver, which becomes a necessary element in the case. The glass picked up should be placed in a large manila envelope, and, as it is difficult to mark for later identification, the author has often used the following procedure, which enables him to later recognize the glass in court: he takes a number of the pieces of glass, lays them on the envelope and outlines them with ink. Thus when he is asked by the defense attorney how he knows that this is the glass he recovered at the scene, he can point out the comparison between the outlines on the back of the envelope and the specific pieces of glass used as a pattern. There is generally little question as to the validity of the evidence. If a piece of glass is found in some specific place, such as in the cross walk or safety zone, and a relationship between that piece of glass and the point of impact is thought to exist, then it is photographed in place and is packaged separately.

It is not essential for a laboratory to try to establish a complete file of all types of headlight lenses; far too many shapes and sizes have been used in cars during the past years. In most large cities there are many companies dealing exclusively in this line to whom one may go for information. The employees in an establishment of this type are generally experts in identifying not only glass but also accessories which may be of aid in tracing a car.

The investigator may find a lens meter of the type used by opticians to be of great advantage. This is an accurate instrument for measuring the curvature of a lens, and it is possible to establish the curvature of a piece of glass as small as one inch in diameter.

If a hit and run car has been repainted after the accident, traces of original paint may sometimes be found on broken headlight or other glass from the car; this may aid in establishing the color of the car involved. Spectrographic examinations may be made of glass found at the scene and compared with glass taken from the suspected car.

Broken Windshield Glass

On rare occasions broken windshield or window glass may be found which will aid in identifying the car. Unfortunately, this type of evidence is not common. If it does exist it may be of even greater importance than the headlight glass, because its presence is so rare.

Broken Parts of the Car

Headlight rims, bumper guards, radiator ornaments, rear-view mirrors, chrome strips, et cetera, may establish the identity of the car as to make and model, for these parts are often specific. Even though there is a similarity between models and cars, the manufacturer generally makes slight changes in shape and size of the trim used on each new model.

Paint

If, at the time of impact, a fender, hood, or body of the car is dented, chips of paint may be dislodged and, when found at the scene, can aid in identification of color, and, often, through use

of color charts, may give the make and model of the car involved.

Tire Imprints

Even though the hit and run occurs on a paved street, occasionally the car swerves before or after the impact in such a way as to cause tires to leave impressions in the shoulder of the highway or in the silt that is sometimes found near the curb line. Where such impressions are found casts should definitely be made.

Articles of Clothing

Hats, gloves, glasses, handkerchiefs, and other articles have at times been lost by the driver at the time of impact. The author has known of cases where car doors have opened and objects on the seat have been thrown to the pavement. This type of evidence is rare, but it is found occasionally.

Dirt from Undercarriage

Sometimes dirt from the undercarriage of the automobile is dislodged; this may consist of a number of layers. An examination of this soil may indicate the locality from which the car has come, or may be matched, layer for layer, with the dirt under the suspected car.

Prints on the Body of the Victim

The outline of radiator grill, tires, or other parts of the car may sometimes be found on the body of the victim, and may have evidential value in court. These prints may be presented in photographs.

Damage to the Car

A study of the distribution of the evidence found at the scene with relation to the skid marks may give some indication as to the part of the automobile damaged. This and any additional information that the investigator is able to gather is vital at this time, for he then can broadcast some individual character-

---

←

Figure 45. Portion of ornament found at scene of hit-and-run.

Figure 46. Ornament as shown in Illustration 45 matched mechanically with remaining portion still attached to suspected car.

Figure 47. Tire print on arm of victim, showing two series of tread markings which compared with tread and sidewall of suspected tire (see Illustration 48).

istic of the car involved, such as right head light damage, dent in left fender, piece of grill work missing. Such information enables the patrol cars in the field to narrow their search.

First Inspection af a Suspected Car

Generally the condition of the clothing of the victim will indicate whether the individual passed over or under the car. In more than 98% of all collisions between an adult human being

Figure 48. Tire suspected of having run over arm of victim (see Illustration 47).

and an automobile the victim goes over or off to the side of the car, and does not at any time come in contact with the undercarriage. This may be readily understood if one visualizes the relationship of the height of a bumper on an automobile to the center of gravity of the average man. The height of a bumper is seldom more than eighteen inches above the ground, in other words, about knee high to a man of average height. In investigating almost one thousand hit and run cases, the author can recall only six in which the victim went under the car; of those six cases,

Figure 49. Small child run over while playing on sidewalk. Note tire tread on face and compare with Illustration 50.

four were small children and the other two were drunks who were more or less prone in the street. Thus it is easy to see that it is useless to waste time placing the car on a hoist when the evidence clearly indicates that the victim passed over the car.

How to Examine the Car

The investigator drives or tows the car into a garage or into some other enclosure which can be darkened, and then examines the surface, using a 500 watt photoflood in a bell type reflector. He plays the light obliquely over various parts of the surface of the car. This procedure will cause any clothing marks to stand out in sharp relief, even though they are not visible in normal daylight. Also, this will enable him to note scratches, small

breaks, and the condition of the surface (whether rusted, which may indicate an old mark, or other conditions which may show the damage to be of recent origin).

Fabric Marks

Probably the most consistently damaging evidence found on a car involved in hit and run cases are fabric marks (marks consisting of a series of parallel striations uniformly spaced and corresponding to the ribs of the fabric that made them). No other object will make marks similar to these.

Stop and analyze what takes place when an automobile weighing a ton or more, traveling at a speed of forty to fifty miles an hour, strikes a human body. If we assume the victim to be a two

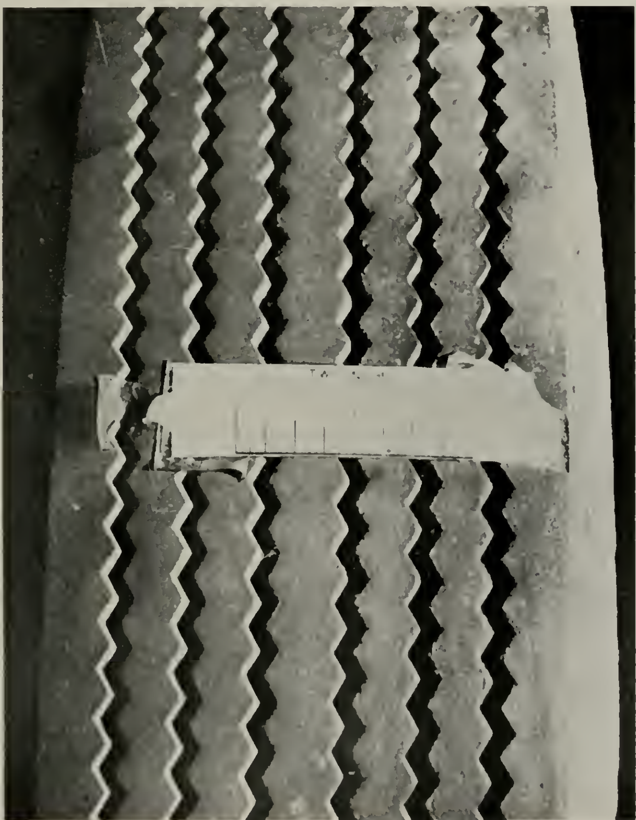


Figure 50. Right front tire of suspected car (see Illustration 49). Note portion between two center grooves is wider than space between other grooves.

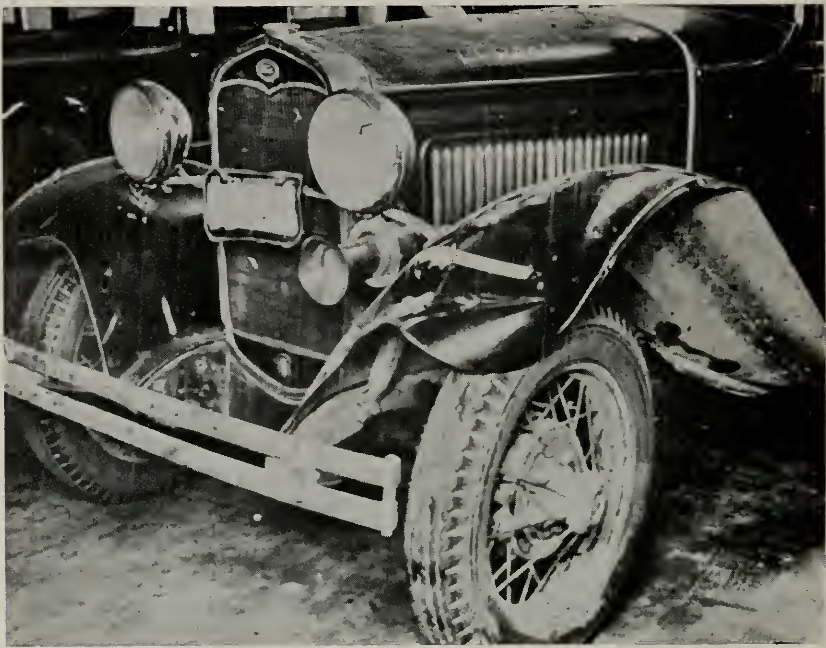


Figure 51. Car involved in hit-and-run accident; point of impact on left front fender indicated by white ruler.

hundred pound man, and if that man were picked up and accelerated from zero to thirty miles and hour in one-tenth of a second, the force exerted on impact would be approximately 2700 pounds! It is easy to see that under such tremendous pressure cloth may burn a series of parallel striations into the surface of the paint. The author has seen cases where the ribs on a piece of cloth of a hard worsted type actually burned the paint or removed it to the surface of the metal.

Photographing Fabric Marks

A tripod camera with a ground glass back should be used and the plane surface of the plate in the camera must be parallel to the surface to be photographed. The marks should be photographed exact size or slightly under, and a ruler should be included in the photograph. The ruler should be perpendicular to the striations. The author has found it convenient to reproduce a portion of a ruler on white photographic paper, exact size, which is flexible and can be bent to the surface of a fender

and then held in place by cellophane tape. A photoflood should then be played over the surface of the car and the reflection in the ground glass noted. Through this procedure it is possible to get the best reproduction of the print. Flash bulbs should be used only as a last resort when electricity is not available. When it is necessary to use flash bulbs, the place at which the flash should be held may be established by first playing a flashlight over the surface until the best possible reproduction of the marks is obtained, then substituting the flashbulb for the flashlight.

Clothing of Victim

The investigator should obtain possession of the victim's clothing as soon as possible. All clothing should be marked, wrapped carefully in clean wrapping paper, and handled as little as possible. Later it may be shaken out or vacuumed in the laboratory; often it will yield many things of evidential value—paint, glass, et cetera. The clothes should be examined carefully in the laboratory for tears. Also, indications that portions of the fabric are missing should be noted. Tears and fresh holes will indicate the possibility that fibres or threads may be found adhering to some portion of the car.

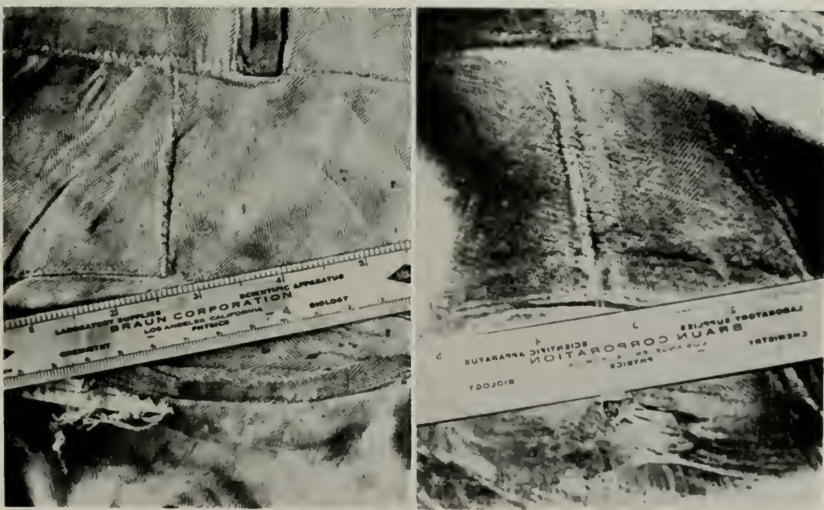


Figure 52. Comparison of photograph taken of left front fender of car (see Illustration 51) with a portion of trousers of victim. The photo of the car fender was taken in darkened garage, using a 500 watt photo flood in a Bell reflector as the light source.

Victim Under Car

When grease is found on the clothing, or when the position of the body would indicate that the car may have passed over the victim, the suspected car should be placed on a hoist and the undercarriage thoroughly examined. For this, a photoflood and a reflector should again be used. Particular attention should be given to protruding bolts and sharp objects which may have caught such evidence as tufts of hair, fibres, threads, skin tissue, flesh, or blood. Little credence should be given to such evidence as hair or fibres unless the grease or dirt on the undercarriage appears to have been freshly disturbed and unless the hair or the fibres are found at this exact spot. A car in its natural daily routine picks up numerous fibres and hair which adhere to the grease on the undercarriage and which have no relationship to the suspected case.

Blood, Skin Tissue, Et cetera, on Car

Sometimes blood or skin tissue or even flesh may be found on portions of a car after an impact. If possible, the part of the car on which the material is found should be submitted to the laboratory intact. If this is impossible, and if a laboratory expert is not available, close up photographs should be made, then the material should be carefully removed and placed in a glass container. Fat tissue and other substances with similar characteristics, if placed in paper containers, have a tendency to be absorbed by the paper. If blood is found on the car and if that part of the car cannot be removed for analysis, the blood should be allowed to dry and should then be carefully flaked off into a glass container. If such a container is not available, a cellophane envelope will suffice. Blood should never be scraped into small manila envelopes, as it is difficult to remove in the laboratory. Minute blood spots on the car may sometimes be deposited there by contact with a blood sucking insect, such as a mosquito or a fly. If the blood spots are extremely small they should be examined through a hand microscope of about ten power to determine their possible origin. If they originate from insects, portions of the bodies may be present. If such are not present, the blood may be removed for analysis.

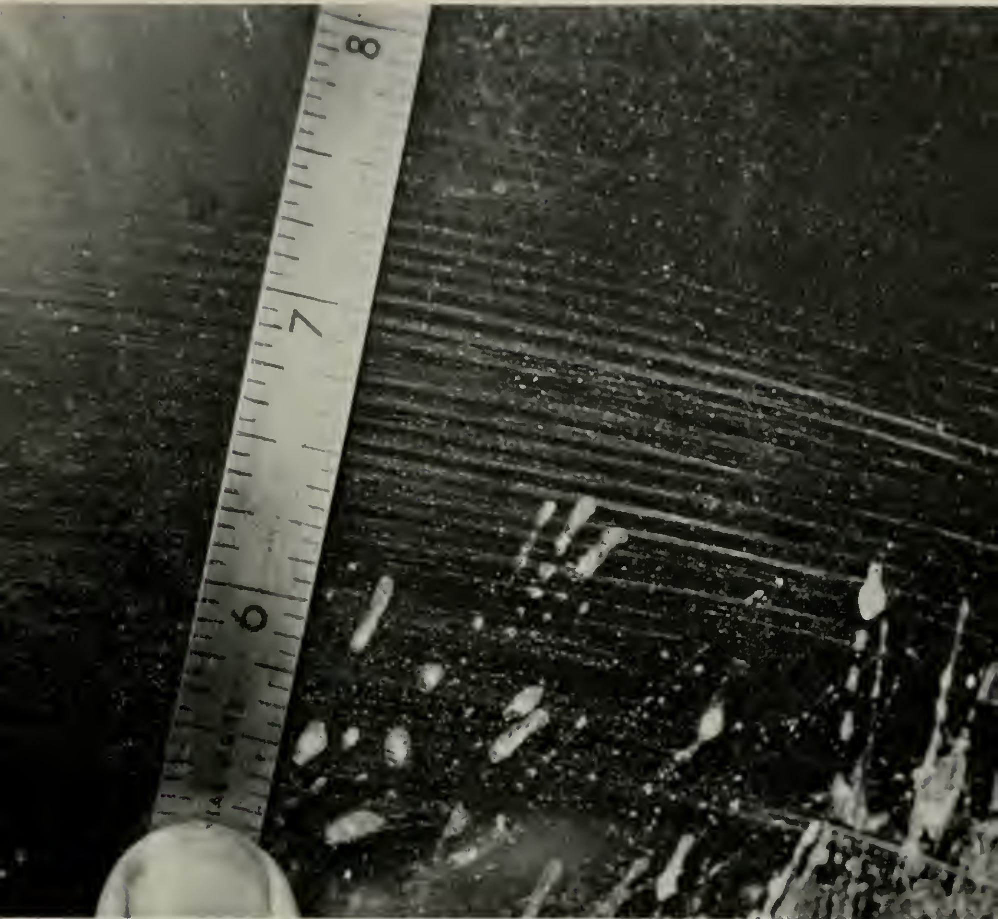


Figure 53. Striations made by fabric moving across the painted surface of a fender. Note the uniform distance between striations.

Articles Carried By The Victim

Sometimes a victim of a hit and run may be carrying packages such as boxes of groceries, liquids (ink, milk, et cetera) that may be broken upon impact. Samples of any of the broken packages should be saved for comparison with the suspected car. Broken strands of beads, the victim's eye glasses, crystal from his watch, or any other such material may be found in the grill work or on some other portion of the suspected car.

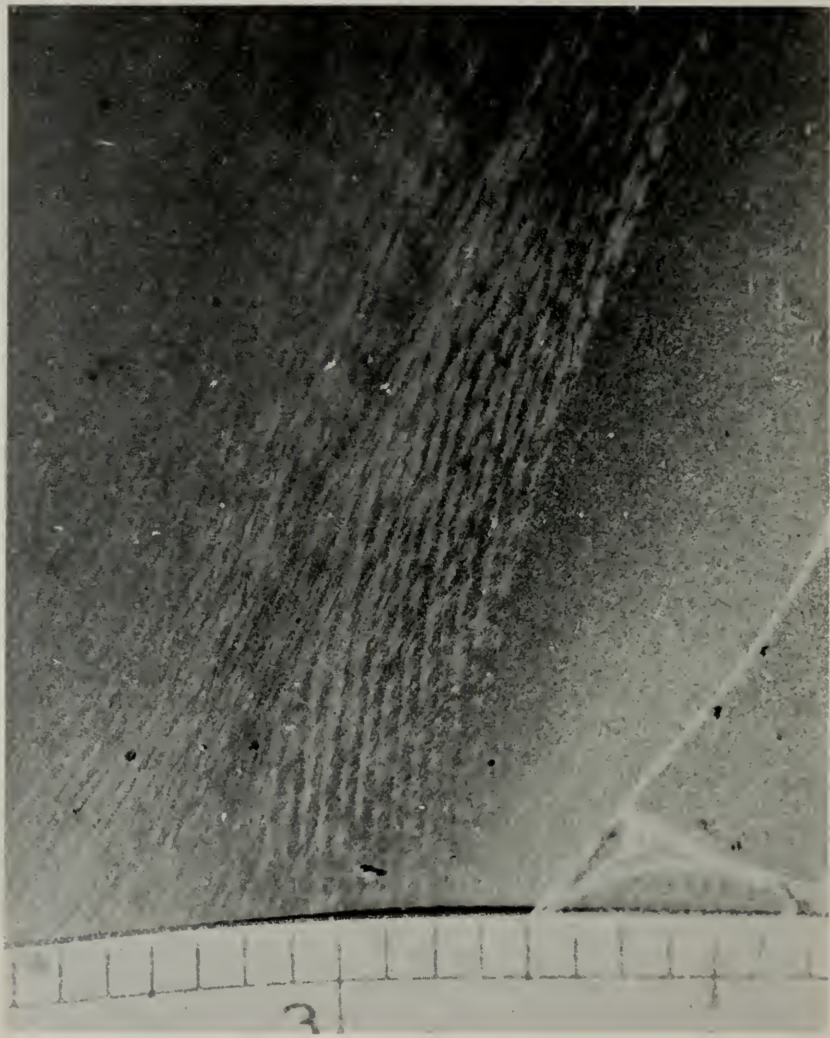


Figure 54. Fabric marks of the "print type" on fender of car. These are a result of a pedestrian-car impact.

Indentations In The Car

A human body coming in contact with the fender, hood, or body of a car generally leaves a typical indentation; in other words, the indentation is cup-like, as if it had been made with a soft object. Dents in cars made by such protruding objects as fence posts, the bumper of a truck, and so on, leave typical scars

which are completely different from those made by a human victim. It is not difficult to distinguish the difference between scratch marks on a car made by coming in contact with the grain of a piece of lumber and those made by fabric. Marks made by the lumber lack uniformity, and the scratches are not an equal distance apart, whereas fabric marks are regular and uniform.

Comparing Headlight Glass

The headlight glass picked up at the scene should be removed from the package in the laboratory and small identifying stickers placed on each individual piece. The glass which has been removed from the suspected headlight should be marked similarly. This is to insure identity of the source of each while comparisons are being made. The most positive type of glass comparison is the mechanical matching of two pieces, one from the car and the other from the scene of the hit and run. In other words, the two pieces are proven to have been parts of one and the same headlight. If pieces are found to match in this way they may be fastened securely together with cellophane tape, and placed in a separate envelope to be taken into court. If no two pieces can be found to fit mechanically, the next best type of comparison is through spectrographic analysis. Even though headlight glass from different batches may be similar in their gross composition, spectrographic analysis will show numerous impurities. These impurities differ from batch to batch, and when two pieces of glass are found to be identical spectrographically, each containing the same gross composition and impurities, they definitely are of a common origin—in other words, they both came from the same original molten mass.

Often when two pieces of glass may be matched together mechanically the place where they come in contact is so small that it is difficult to show the court that they actually do coincide through contour pattern. This difficulty is due to the fact that glass, being more or less transparent, is not too easy to photograph. In such cases it is possible to photograph the contact surfaces of these two pieces of glass, using oblique light; this will show a characteristic break pattern. These patterns may then be enlarged and, by superimposing one over the other, the definite relationship may be shown. Glass may also be compared through

comparing the specific gravity of the pieces, and even though this is not too definite, it does have evidential value. Refractive index often differs between various batches, although again this is not as specific as other means of identification.

Headlight Rims

Headlight rims found at the scene of a hit and run occasion-

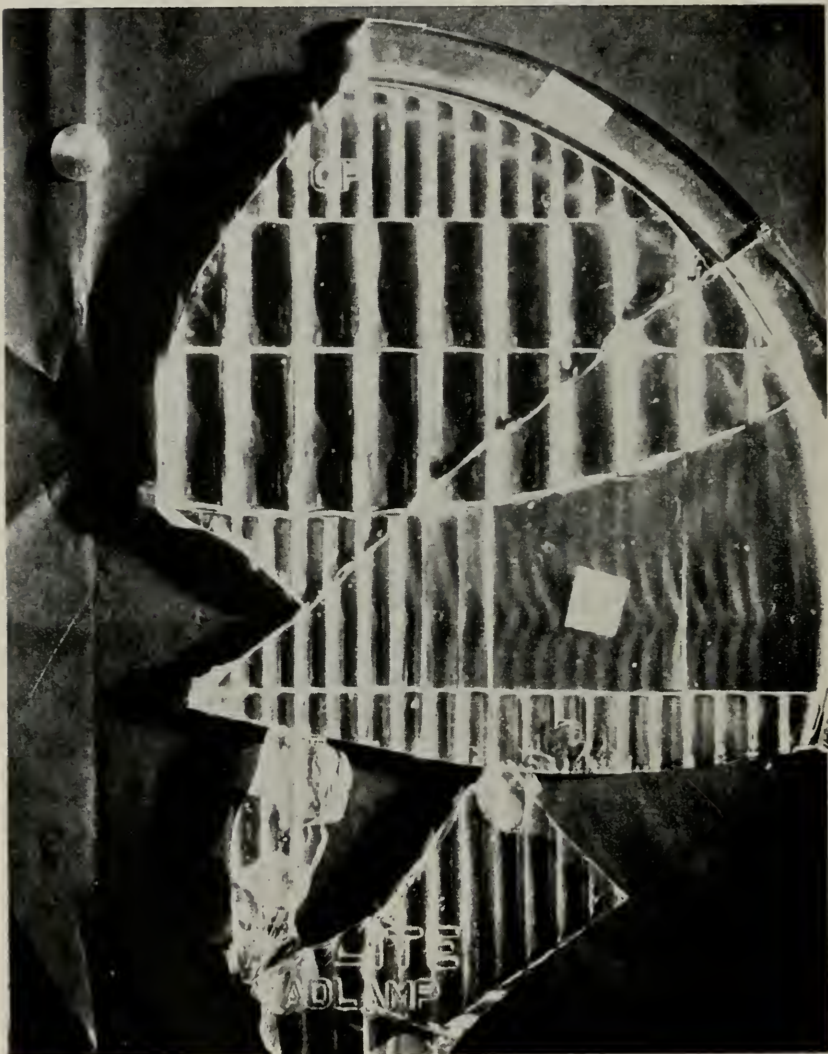


Figure 55. Two small pieces of glass, at bottom, found at scene of hit-and-run. Two large pieces, at top, removed from right headlight of suspected car.

ally may be proved to have come from a certain headlight by tracing minute scratch lines from the rim to the headlight itself. During the process of polishing or wiping off a car, minute grains of sand may be picked up on the polishing cloth and the hair-like scratches which they leave can be traced for comparison. Again, this will most readily show up through the use of a photo-flood.

Figure 56. Break striations on matching surfaces of glass from headlight. Photo made with oblique lighting. Left, broken surface of small piece found at hit-and-run scene; right, large piece from suspected car. (see Illustration 55).

Comparing Suspected Fabric Marks With Clothing

The photographic print of fabric marks should be made exact size, which is assured by having the ruler in the original picture. By using a stylus under a wide field stereoscopic microscope, the number of scratches or striations per inch can be counted. Then, with the clothing under the microscope, and with a ruler placed perpendicular to the ribs, the number to each inch can also be counted. Thus if a relationship exists, it may be de-

termined. At times the fabric marks on the car will show a greater count to the inch than will the cloth that made them. This is not uncommon. At the time of impact the victim may bend a knee or an elbow, or the cloth may be tightly stretched across some portion of his body. This stretching effect will cause the ribs to move closer together, and will account for the discrepancy mentioned above. It is rare indeed to find the count of the striations on the car to be less than those of the clothing. The victim may also be wearing clothing of different weaves, such as a sport jacket of one weave and trousers which are entirely different. He may also have an overcoat of a third pattern, or a shirt of still another, therefore it is necessary to look the car over carefully for various patterns. A herringbone type of suit may leave two or three different striation count, dependent entirely upon which set of ribs of the cloth came in contact with the car. A woman's costume generally has a variety of fabric weaves, and even such articles as slips and hosiery, because of the

Figure 57. Photograph of break striations (see Illustration 56) of small piece of glass, superimposed over photograph of break striations of larger piece of glass. A small window was made in the upper photograph for comparison.

disarrangement of clothing at time of impact, may reproduce typical marks. This may occur even though it may seem impossible that they could have come in contact with the surface.

Side View Mirrors Dislodged

Where the side view mirror bracket has been dislodged from the car it may be possible to prove that it came from that particular car by photographing the place where the bracket had originally been clamped and by then comparing the contour pattern of that photograph with the face of the bracket itself.

Paint Comparison

Small particles of paint found in the victim's clothing may be compared with paint from a suspected car as to number, color, and thickness of layers. If a sufficient quantity is found in the clothing or at the scene, a spectrographic analysis may also be made.

Case Histories

1. A four year old child was run over and the car was traced through a statement made by his playmate to the effect that he saw a small toy dog on the rear bumper of the car. The car was located a few blocks away and further identity was made by comparing the left front tire of the car with a tire tread printed on the victim's face.

2. In another hit and run case it was possible to identify the exact portion of the victim's trousers that came in contact with the fender of the car through comparing weave marks, wrinkles, belt loop, and seam.

3. A girl was struck by a hit and run and was thrown over the hood, her lips coming in contact with the top of the right front fender. She was not killed, but her back was badly injured. A suspected car was located through tracing a partial license plate number. The lipstick print was discovered, was removed with cellophane tape, was placed on a white background and was photographed. These photographs were compared with lip print exemplars from girl's lips, and seventeen points of identification were noted.

4. A hit and run car was identified as having struck three victims through the following comparisons: red leather from the boots of one of the victims transferred to the bumper of the car;

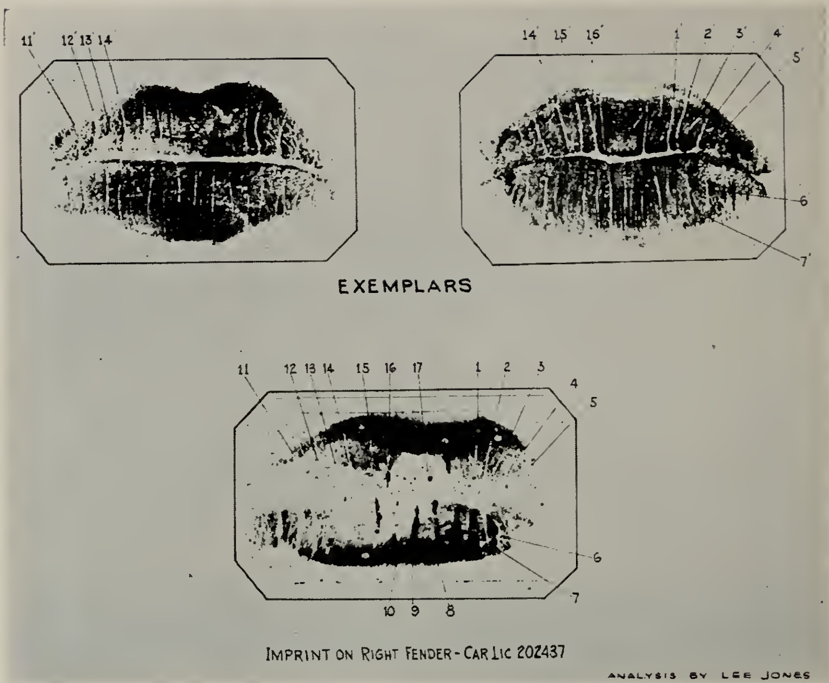


Figure 58. At top, exemplars of lip print taken from a hit-and-run victim at hospital; below, lip print removed from right front fender of suspected car. Print on car was lifted with cellophane tape and placed on white background before photographing. Color of fender made it difficult to photograph in place.

clothing marks of his trousers on the fender; red leather of a different shade transferred from his jacket to the hood; aluminum paint from the bumper transferred to the boots; hair and skin tissue from the right side of his forehead transferred to the right post of the windshield.

5. A chip from the tire of a suspected car was matched through contour pattern, tying that car in with a hit and run.

6. Samples of five different foods—rice, flour, breakfast cereal, salt, and sugar—were found in the grill work and radiator of a car suspected of being involved in a hit and run. These foods had been carried by the victim.

7. A small piece of glass (one-eighth inch) found in the clothing of the victim was proved to have been chipped from a parking light of a suspect's car by tracing marks made by the buffing machine at the time the lens was polished.

8. A motorman was struck and killed as he stepped from the front of his streetcar. The wire screen from a Ford horn was dislodged at the scene, also pieces of white paint. The hit and run vehicle was identified by witnesses as being a small delivery truck. Such a truck was located at a laundry a few days later and the car was identified by proving that the wire screen mesh had rested in the horn of that car at the time it was painted. Headlight glass had also been found, and through the combination of the above

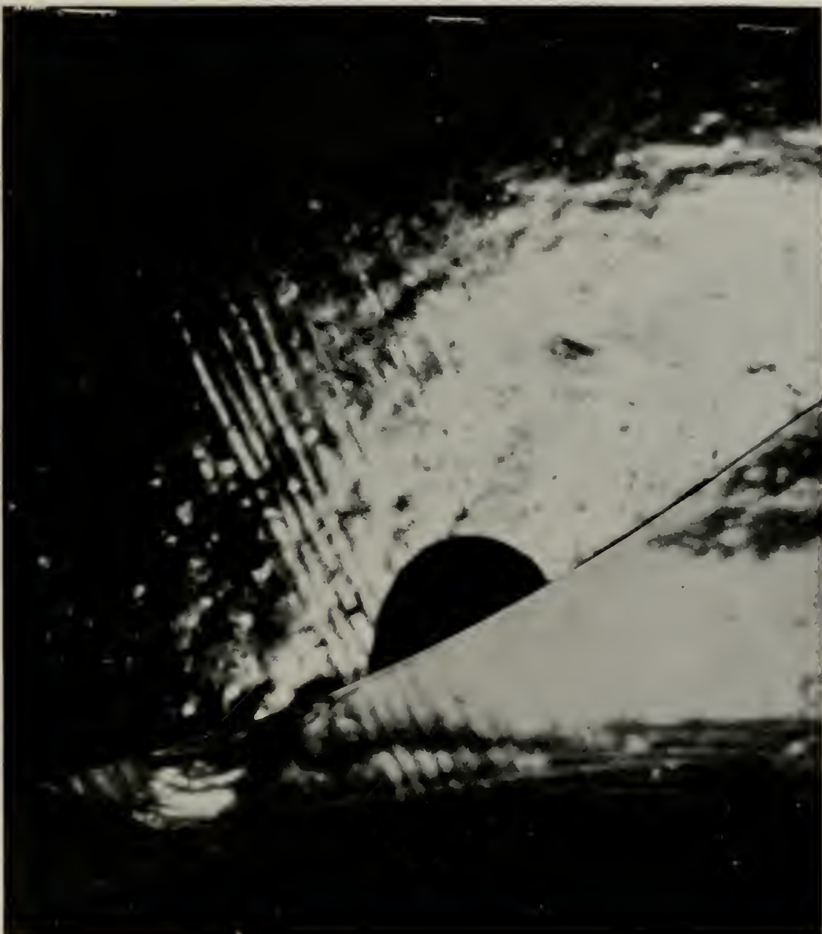


Figure 59. Top, broken piece of glass found in clothing of victim; bottom, portion of parking light on suspected car. Striations are the result of manufacturing process. They prove that both pieces of glass came from the same original piece.

mentioned evidence and the spectrographic analysis of the paint and glass, positive identification was established and the man was convicted.

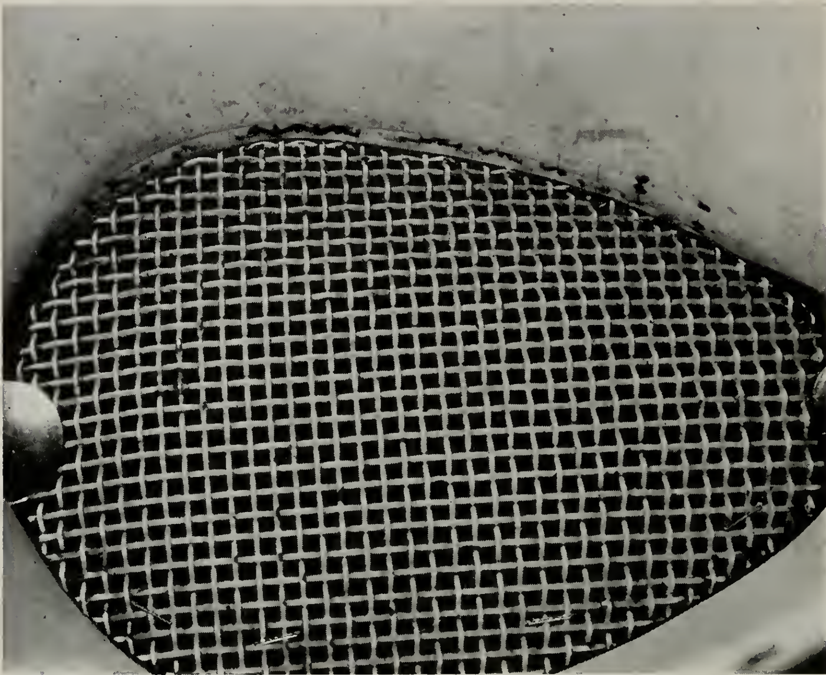


Figure 60. Screen found at a hit-and-run scene superimposed over photograph of horn of a Ford truck. Black lines at the edge show where portions of the screen had blocked out the surface when horn was painted.

9. A piece of chrome trim found at the scene of a hit and run was proved to have come from a suspected car by matching rust marks on the underside of the trim with corresponding marks on the car.

X

HOMICIDE INVESTIGATION

The homicide investigator probably utilizes the full facilities of the crime laboratory to a greater extent than does any other type of investigator. If there are witnesses, he needs corroborative evidence; if there are no witnesses, the entire case must often be proved through physical evidence alone.

There is no such thing as a perfect crime—there is only the inability to find the evidence.

Curiosity seekers may inadvertently destroy such evidence as footprints, blood stains, et cetera, before the investigator arrives at the scene, and even he, if the investigation is not handled systematically, may pass up the very thing that could bring about a solution to the case.

There are generally two phases in the average homicide case: (1) that portion from the discovery of a body to the time an experienced investigator arrives at the scene, and (2) the investigation itself. Each is of equal importance.

The Preliminary Investigation

The first officer to arrive at the scene of an alleged homicide, whether he be from foot patrol, radio car, or traffic has two immediate responsibilities: (1) to examine the victim for signs of life, and (2) to protect and preserve all physical evidence. The first may be immediately obvious, with no necessity for him to approach the body at all. If this be the case, his primary job is to protect the entire vicinity until help arrives. Natural barriers, such as fences and ditches, may aid him in keeping the crowd back. When the body is in open terrain it may be necessary to set up some form of a temporary fence of stakes driven into the ground and connected with rope. Some departments maintain just such emergency equipment—iron stakes with loops in the top for threading rope. This type of an enclosure can be set up quickly and will aid in holding back any crowd that may arrive.

The officer may have some difficulty with the press, but generally newspapermen will cooperate if handled in the right manner.

When the body is in a house or some other enclosure, the officer should prohibit anyone from prowling in the immediate vicinity of the house itself. Often footprints, if found anywhere on the premises, may be of vital importance. A recent Los Angeles murderer was brought to justice through the identification of his shoe as the one which had made an imprint in the soft dirt beneath a bedroom window. An officer may see footprints leading to or from the scene of the crime. He should cover some of the better ones for later casting, or until their origin is established. Any other physical evidence should be left in position until the investigators arrive.

The Real Investigation

When the homicide officer arrives, the case becomes his problem. It is his responsibility to detail sufficient men to protect the entire scene until he has completed his investigation. He should not hesitate to stop anyone from approaching the body until a definite systematic procedure has been carried out.

He should approach the body carefully, searching every foot of space as he goes, noting such things as footprints or other evidence. It is an excellent thing if a criminalist can be with him from the beginning. Each square foot and each part of the entire scene should be searched and examined carefully; any evidence found should be left in its exact position, and should not be disturbed in any way. The body, and any weapon found, should not be moved.

This preliminary survey is to acquaint the investigating officer with the entire scene and its important details. After he has completed his preliminary survey the photographer may go to work. The investigating officer should accompany the photographer, pointing out various objects of possible evidential value. He should see that the body is photographed from all angles, including photographs taken from above. It is also his responsibility to see that blood stains, bullet holes and powder residues are photographed. He should note possible locations of fingerprints and guard against the contamination of such objects and surfaces.

After the general scene has been completely photographed, he should bring in the officer with casting equipment, and aid him in casting all possible foot imprints, if such are present. The photographer should photograph footprints on hard surfaces as he systematically photographs the rest of the scene.

When the scene has been sufficiently covered, so that it is safe for the officers to move about more freely, the fingerprint man should be permitted to work on such various points of importance as doors or other places of entrance. The fingerprint man should also note various movable objects where fingerprints may be found, and should carefully remove them to some secluded place for dusting at a later time.

As the fingerprint man completes his search for prints on such large objects as dressers and cupboards, the homicide investigator may go to work examining their contents for articles of possible evidential value. Of course this does not mean that the investigation has been at a standstill while each specialist completes his work. Other paths of the investigation, such as interrogating witnesses and running down leads, may be continuing simultaneously with the investigation of the scene, but it is common sense to realize that evidence of great value may be found on the ground or on the floor itself—if the investigator carelessly walks around without locating and preserving such evidence he may very well destroy that which could help him solve his case.

The part played by the photographer is of prime importance to the investigator, for photographs enable him to present in court at some later date the true picture of the scene as it was when he found it. This cannot be done if such objects as guns or knives are inadvertently handled before photographs are made. It is a physical impossibility to replace objects exactly as they were, once they have been handled. The same thing is true with the fingerprinting procedure, only in this case the prints themselves are generally not obvious, thus the investigator and the fingerprint man must cover all possible places where prints may be found, for they must not be destroyed as the investigation proceeds.

As evidence is found it should be marked, carefully wrapped in paper, and placed in some locality where it will not be in-

jured or contaminated. This does not include objects still wet with blood. Objects such as these should be permitted to dry before being transported to the laboratory. If the criminalist is present, various objects may be tested chemically or examined with a low power microscope to determine their possible value as evidence.

The photographer should remain at the scene and make photographs from time to time as is necessary. For instance, if a knife is found beneath the body it should be photographed in place when the body has been turned over. If the hand of the victim is clasping hair or some other object, this should be photographed, if possible, before moving the body. There may be many steps during the removal of the body when it may be advisable to take photographs. It is well to make a number of color shots of the scene; also, a few general shots from various angles, using color in a stereo camera, should be made. These photos will aid the jury in visualizing just how the scene appeared to the investigator and in realizing the relationships of various pertinent objects.

After the coroner has moved the body to the morgue it may be necessary for the investigator to spend some time at the scene going over papers and other articles for possible clues. He should make arrangements and find out the time set for the posting of the body, for he should definitely be present when this is done.

All officers at the scene of a homicide should be extremely careful in expressing their opinions to newspaper men or to other laymen who may be present. Officers must not jump to conclusions. Of course it may be obvious that the case in question is a homicide, but even then it is better to await the autopsy report before expressing opinions. Often what appears to be a homicide may be later proved to have been accidental death or suicide. No relative wishes to believe that a dear one has committed suicide, and he may resent any remarks intimating such. It will be far more difficult to reconcile him to the fact that it was suicide if some officer has inadvertently planted in his mind the idea that the case is unquestionably homicidal or accidental. Many times large sums of money from life insurance policies are involved, and if the case is suicide the relative stands to lose financially. In a Los Angeles case a police officer, upon viewing

a body found near a backdrop in a moving picture studio, made the statement that it was unquestionably a hit and run case, and even though it was later proved that the victim was drunk and, through his own negligence, had fallen forty or more feet from the catwalk at the top of the backdrop, his relatives would not give up, as a clause in the insurance policy made it void if the insured accidentally lost his life through his own carelessness. The case was carried through numerous courts in an attempt to prove that the man was a hit and run victim.

Sudden Death From Natural Causes

It is not uncommon to find a dead body with the cause of death not apparent. Even though bruises and lacerations are visible, these may not always be the results of foul play. The person may have fallen or may have injured himself in some other way as a result of sudden death from natural causes.

To enumerate a few of the things that may cause sudden death, we may list the following:

1. Heart trouble.
2. Apoplexy or brain hemorrhage.
3. Abscess or tumor of the brain (this may cause a person to be found unconscious in the street, an apparent victim of a hit and run).
4. Throat constrictions.
5. Abdominal condition, such as ruptured appendix.
6. Ruptured genital organs, tumors, et cetera.
7. Infectious diseases, such as chronic and acute kidney disorders, influenza, typhoid, et cetera.
8. Stricture of intestinal tract (usually small children).

It is important to remember that when no cause of death is found one must exclude death by violence and by most poisons. Also it is generally necessary to establish cause of death before an accusation will stand.

Again, too much emphasis cannot be placed on the necessity for the investigator to attend the posting of the body. It will enable him to see first hand the nature of the wounds, and to insure that sufficient photographs are made depicting these wounds. For instance, he may be able to gather first hand information as to the size and depth of a knife wound, whether

the instrument had a single edge or two edge blade, and the locality of the various wounds. He can also note the condition of the hands—whether or not the victim had defended himself. If no criminalist is present he can arrange to have the fingernails clipped, hair samples taken (both head and body hair), et cetera. If the wounds have been made by a gun he can note the powder burns, if any are present, and the direction, entrance and exit of the bullet. He may also note the removal of the bullet, if it is still in the body, receiving it from the autopsy surgeon firsthand, for delivery to a laboratory. He can also see that the clothes are properly folded and packaged, and gain much other information which would be difficult for him to obtain by reading the autopsy report. Discussion of the case with the autopsy surgeon may bring out pertinent information.

Photographing the Body at the Morgue

Even though numerous photographs have been taken at the scene of the crime, it is very essential to complete the series at the morgue. After the clothing has been removed from the victim, various angle photographs should be made of the wounds before they are cleaned, and again each wound or series of wounds should be photographed after the body has been washed. Careful photography of the shape of the wounds, depressions in the skull, et cetera, may aid in locating the weapon used. The autopsy surgeon may be able to insert a probe, showing direction of a gun shot wound which may aid in determining the position of the assailant. This should be photographed. Skinned knees, various bruises on the body, cut or lacerated hands, should all be photographed.

Bites, imprints, or other marks which are visible on the body should be photographed perpendicular to the plane surface on which the mark is located, and a ruler should be inserted alongside the mark for future size identification.

All photographs should be taken before the body is turned over to a private mortuary, as the detective will encounter difficulty if he endeavors to get additional photographs after the body has left the custody of the coroner. The private mortician has his client to think about, and he does not countenance having the body placed on display for photography. This is true especial-

ly if photographs are required of bruises or bites on the body of a female in such places at the inside of the legs, or around the labia majora of the vulva, or even on the breasts.

Samples of Hair, Et cetera

It is a good procedure at the time of posting to obtain samples of head and pubic hair. These samples should be taken by removing the hair intact, which would include the shaft, tip, and bulb. Exemplars of other body hair may also be taken if this is deemed necessary.

Fingernail Clippings

The fingernails should be clipped closely and those from each hand preserved in separate containers, each container marked as to its identity. Clipping the fingernails is better than trying to clean the dirt from beneath them, as evidence may be lost or destroyed if the latter method is used.

Blood Samples

The coroner will generally take samples of the blood of the victim, also stomach contents, parts of the viscera, et cetera, for future analysis, but samples of blood should also be received by the detective to be submitted to the laboratory for any other analyses which may later be needed.

Cremation of Bodies

Cremation generally destroys everything, with the possible exception of some of the heavy metals. When there is any possibility that the body will be cremated, it is obviously necessary that a thorough sampling for analysis be made before such procedure is permitted.

Time of Death

Before deciding on the time of death, all conditions of the body must be thoroughly examined. Each case must be judged upon its own merits.

When the body is found a short time after death much information can be gathered from the temperature of the body. Again this temperature is relative to surrounding temperatures,

and also the amount of clothing with which the body is covered. A body exposed to subzero weather will cool very rapidly, and would probably become frozen before rigor mortis could set in, yet if the surrounding temperature were, let us say, between eighty and ninety degrees, the body temperature would drop very slowly.

Rigor Mortis

Many diversified opinions have been expressed concerning the condition known as rigor mortis. Immediately after death the body is generally in a relaxed condition, yet the individual cells are still living, and may react to stimuli. The first death is referred to as somatic death, but after the cells have died it is then referred to as cell death. Generally the elapsed time between somatic death and cell death in a human being does not exceed three or four hours.

Rigor mortis is apparently not related to the nervous system, but is dependent upon the amount of lactic acid and phosphoric acid present in the tissues—at least these acids are known to increase at the time of the inset of rigor. Again, variations of this hypothesis have been advanced by various authors, but it is evident, at any rate, that the acid is produced in the muscles in sufficient amounts to cause a coagulation of the muscle proteids.

Time and Conditions of Onset

Generally, rigidity has proceeded through the body to a considerable extent within approximately five to six hours. It begins in the lower jaw, sometimes even as early as two and one half to three hours after somatic death. It gradually spreads through the muscles of the body, passing through trunk and arms and finally to the extreme portions of the legs. Every muscle of the body is affected by rigor. Again the onset of rigor is dependent upon other conditions—atmospheric temperature, age and physical condition of the deceased. In one case handled by the Los Angeles Police Department, a woman was found strangled, but there was no sign of the inset of rigor eleven and one half hours after the time of death. Even the muscles in the jaw and throat were soft and pliable. Rigor began in this case about twelve hours after death and within two hours was complete. The time of death had been established conclusively through witnesses.

Temperature

Cold slows down the inset of rigor, while heat hastens it.

Physical Conditions

Active exercise, excitement, or fatigue prior to death, hastens rigor.

Duration of Rigor

Rigor mortis may last a variable length of time, ranging from thirty to forty hours up to sometimes more than three days. It may begin to pass off if the temperature is warm even as soon as twenty-five hours. Generally, however, this occurs within thirty or forty hours. Cold weather may retard it to such an extent that rigor has not completely passed for two and one-half to three days. In another Los Angeles case the deceased was still in total rigor eighty-five hours after death.

Post Mortem Lavidity

When a body is permitted to lie in the same position for some length of time after death, the blood will have a tendency to gravitate or flow to the lower portions of the body, where it will become congealed in the capillary veins of the skin, giving a purplish color to that portion. This may become of evidential value in establishing the fact that the victim was moved sometime subsequent to death.

Post mortem lavidity begins to appear shortly after death. If the body is moved within a short time the lavidity may change to some extent, to reappear in the underneath portion of the new position, but if the body has lain in the original position for a period of four or five hours, any subsequent change in position can be definitely established. Post mortem lavidity should not be confused with extensive bruises that may be found on the body. The autopsy surgeon will be able to readily distinguish between the two by sectioning a portion of the area.

Post mortem lavidity will not appear where the body is actually in contact or is resting on the surface itself; in other words, a body on its back will not show the customary coloring on the shoulder blades or on the buttocks, nor will this coloring show beneath such tight objects as garters or girdles. It is only in the

free underneath portions, where the blood can gravitate to the vein capillaries, that these discolorations will be apparent.

Cadaveric Spasm

Sometimes at the instant of somatic death the whole body may undergo a rigidity similar to rigor mortis. This is probably due to a nervous condition, and has been noted in a number of suicides when the wound was inflicted in the chest. In this condition the muscles of the hands may grip the gun with such a degree of firmness that it can be removed only with difficulty. Other examples of rigidity after death may be found by noting objects clutched in the hands of victims of drowning.

A cadaveric spasm cannot be simulated. It is impossible to kill and then try to force the victim to grip the gun with the tenacity found in a true cadaveric spasm.

Adipocere

Adipocere is a whitish-gray, soapy substance which forms on the surface of the body, generally around the face and head. This occurs frequently where the cadaver has been buried in damp ground, or in drowning cases. It has a rancid odor and is slightly greasy to the touch. It may also have a brownish color. It is lighter than water, and is soluble in ether or alcohol. It is the result of the formation of palmitic, stearic and hydroxy stearic acids.

Adipocere may act as a preservative to that part of the body on which it occurs. In certain cases where it had extended over the surface of the face, the features were discernible even after a number of months.

Identification of Body

The identification of a body is dependent upon many factors, and also upon the condition under which it is found.

In many cases, identification may be made through fingerprints, yet often victims of homicides have never had their fingerprints registered by any agency, and even if their prints are on record, decomposition may have reached the stage where fingerprinting is impossible.

Positive identification is generally essential before an ac-

cusation will stand, and, as previously stated, there are numerous factors to consider. These will be taken up under separate headings.

Skeletal Identification

A differentiation between male and female through means

Figure 61. Victim shot five times in the chest with a forty-five. He was sitting on a bar stool at the time. He fell from bar stool into the position shown in photograph. He remained in this position for twenty minutes after investigators had arrived. Note the cadaveric spasm of right leg.

of the skeletal structure alone is not always definite. There are certain characteristics of the skeletal structure that are typically male, while others are typically female. To cite a few: difference in shape of pelvic bone (wider in female than in male); difference in length of sacrum—tail bone (longer in female than in male); shape of skull; and dip at top of nose (deeper in male than female). It is necessary that the sum total of all of these be taken into consideration, and even then there are all gradations of body structures. Some of the best medical men may find themselves stymied in making a positive differentation. There is no chemical test for sex.

Individual Identification

Of course the simple method of identifying a homicide victim is having the body identified by relatives or friends, or by comparing photographs, but often this procedure is not possible and other more complicated means may be necessary.

1. *Fingerprints.*
   When the condition of the body permits, it should be fingerprinted even though apparent identification has been established. If the body has been mutilated, the party viewing the deceased may be so emotionally upset as to make a false identification.
2. *Dental Work.*
   A complete chart of the teeth of the deceased may be a positive means of identification. The examination should be made by a dentist, who will mark on a chart the location of each tooth and any fillings, inlays, crowns, bridgework, cavities, or dentures of any type, indicating the relative size of each. Photographs should also be made. If a description of these charts is published, a dentist may note similarity to work which he has previously done for one of his patients. A dentist can generally recognize his own technique, and would be able to make a positive identification upon viewing the teeth of the deceased.
3. *Scars, Tattoos, Et cetera*
   Each scar or tattoo mark on an unidentified body should be photographed, with the camera perpendicular to the plane surface to prevent distortion. Abdominal and other

scars resulting from major operations, if carefully photographed, may be recognized by the physician who originally operated, as each has his own operative technique. Broken bones, bunions, deformities, and moles, if such are present, should also be photographed. In a Los Angeles case in which the head and hands were missing from an unidentified murder victim, positive identification of the body was made by a chiropodist who viewed the feet of the deceased. He stated that he recognized the size and shape of a bunion he had treated. If it is thought that the victim may have previously had a bone fracture, it is a good procedure to have that portion of the body x-rayed. Positive identification may be made in this way.

Locations of moles or pock marks have been used as a means of positive identification when compared with a photograph of the deceased, even though a decade or more had elapsed since the original photograph was taken. Positive identification may be shown through triangulation (plotting the relationship between the mole or pock mark with other definite parts of the body). For example, a mole on the cheek may be seen in a side view photograph. If that photograph is enlarged to natural size and lines are drawn from two of these points: the ear lobe, the corner of the eye, or the point of the nose, to the mole in question, the enclosed angles can be measured. This photograph can then be compared with another taken of the deceased and if the two coincide may aid in a positive identification.

Clothing, Cleaners' Marks, Et Cetera

Clothing has been the means of identifying the deceased in numerous homicide cases, either by relatives or friends recognizing the clothing itself or through papers, cards, and other articles found in pockets, in billfolds, or in purses.

One of the finest means of identification—cleaners' marks—has often been of little value, due to a lack of cooperation from the cleaning industry as a whole. If each state would pass a cleaners and dyers mark law making it mandatory for each and

every cleaner to use an identification mark assigned to him, the problem could be greatly simplified. Legislation could be set up in this manner:

A master file could be established in the State Identification Bureau. The bureau would then assign to each cleaner and dyer (licensed by the state anyway) a mark consisting of a letter-number combination, such as A-1, L-2, R-5, et cetera. These marks would be placed upon all cleaning when it is possible to do so without injuring the garment. This procedure differs very little from that followed by the industry at the present time, but it would enable the investigating officer to quickly establish where a certain garment had been cleaned by merely contacting the bureau.

Cleaners now use such marks, but because of a lack of regulation, dozens of cleaners in the same city may use identical marks.

A file was established in the Los Angeles Police Department in 1943 and at that time there were thirteen cleaners using the symbol A-1; twelve using A-2; in fact, there were few marks for which no duplicates were found.

Computing the following: A-1 to Z-99; 1-A to 99-Z; A to ZZZ and all intervening combinations, eliminating the letters I and O, there are 31,872 possible combinations.

A bill to this effect was entered in the State Legislature of California in 1943, 1945, and again in 1949, but as it was opposed by the cleaning and dyeing industry it was defeated.

Decomposition of the Human Body

Decomposition of the human body is dependent upon many factors. The mouth, throat, and intestinal tract at all times are teeming with bacteria which, when given an opportunity, break down the tissue with great rapidity. For example Escherichia coli, Escherichia communior, Proteus vulgaris, and Alkaligenas fecalis are common habitants of the human colon; most of these aid in the process of putrification.

The general order of decomposition of the human body is listed below:

1. Larynx and trachea.
2. Stomach, intestines, and spleen.

3. Liver, lungs, and brain.
4. Kidneys.
5. Heart.
6. Bladder.
7. Uterus.

It may be noted here that these portions of the body which decompose first are the ones previously mentioned as being normally infested with bacteria. Bacteria gradually spread out from these areas using the arteries, the veins, and the capillary structures, until the entire tissue is affected.

Temperature

Temperature, of course, plays an important part in decomposition. In subzero weather a cadaver may remain for an indefinite time if protected from other destructive forces, while in the warmer climates decomposition is rapid. In tropic areas, where bodies are subjected to warm, moist air, they decompose exceptionally fast, sometimes requiring an elapsed time of only a few days to practically disintegrate.

Moisture

Bacteria cannot work without moisture. For that reason, when the deceased has had dropsy or some other systemic disease which has filled the body with an excessive amount of liquid, decomposition is more rapid. Conversely, an emaciated type individual decomposes more slowly.

Access to Air

Most of the putrifying bacteria are aerobic (need oxygen to function). For that reason, access to air aids decomposition.

Age of Deceased

The age of the deceased may have some bearing on the rapidity with which it decomposes. Newly born, unfed babies decompose very slowly (absence of bacteria in mouth, throat, and colon). As stated above, in bodies of older, emaciated type individuals, decomposition is retarded.

Mutilation

Cuts, stab wounds, et cetera, aid in decomposition, as bacteria have been introduced directly into the tissues.

Obesity

Bodies of fat persons decompose more rapidly than those of thinner individuals.

Alcoholics

Although one would be led to think that the corpses of alcoholics would decompose less rapidly than other types of individuals, most authorities hold that this is not true. They actually decompose more rapidly than is normal.

Bodies in Deserts

In arid climates, because of the speed with which a cadaver is dehydrated, bacterial action is checked before decomposition has had a chance to proceed to any great extent. Mummification usually results.

Clothing

Tight clothing may slow the process of decomposition in certain portions of the body. This is especially noticeable in that portion of the cadaver directly beneath such articles as garters and tight girdles. Articles of clothing of this type, in pressing tightly against the body tissues, force the liquid portion from the outer capillaries, thus hindering the progress of the bacteria.

Rodents

Rodents and other animals may aid decomposition by mutilating the cadaver. Even if actual destruction of the body does not take place, lacerations made by these animals introduce into the tissues bacteria which enhance the speed of decomposition. Rats have a tendency to attack such portions of the body as eyelids, nostrils, lips, and other soft tissue. In one case, the eyelids were completely devoured within a four hour period after death. This was proved to have been the work of rats by noting minute scratch marks made by the nails of the animal during the process of tearing the tissue away.

Suicides

When an individual has decided to commit suicide he may use various ingenious methods to accomplish his objective. If he is insured, and if he realizes that his policy contains a clause

making it void if death is suicidal, he may endeavor to take his life in such a manner as to make it appear to be accidental or homicidal. As previously stated, relatives and friends are reluctant to accept the theory that the deceased has taken his own life. They often maintain that, because of his religious beliefs, it would have been an impossibility for him to have committed suicide, but it has been found that religion has little deterring effect on the potential suicide, once he has made up his mind.

Poisons

One of the prevailing methods of suicide in recent years has been by sleeping tablets or barbiturates. Suicides may resort to various other types of poisons, generally those easily accessible in the normal household. Such poisons as ant paste (arsenic), poisoned grain used to kill rodents (strychnine), disinfectant tablets (bichloride of mercury), garden sprays (arsenic and nicotine), and iodine and lysol are all commonly found in or about the average home, and are potential sources of poisons for the would-be suicide.

Carbon Monoxide Poisoning

Suicide by carbon monoxide poisoning is another method commonly used. Potential suicides may turn on the gas jets in a room, may accomplish the act in a garage by allowing the motor to run with the doors closed, or, as has happened in some cases, may connect a hose to the exhaust pipe, thus piping the partially burned gasses inside a closed automobile. When this method is used, the deceased will generally have the typical flushed, cherry red appearance of carbon monoxide poisoning. The carbon monoxide is picked up by the red corpuscles from the lungs of the victim and is carried back and forth through the body, adding more and more gas, until death finally ensues. The red corpuscles have about two hundred times the affinity of carbon monoxide gas as they do for oxygen, thus it is easy to see that if the carbon monoxide is once picked up by the corpuscle it is not easily displaced, and has an accumulative action.

Cutting Throat and Wrists; Stabbing

Suicide may be accomplished by cutting the wrists, the throat, or by stabbing. Sometimes superficial cuts will be noticed around

the wounds. These are preliminary attempts made during the period when the suicide was endeavoring to build up courage enough to complete the act.

Gunshot Wounds

Finding more than one gunshot wound in a body does not always eliminate the possibility of suicide. It is not uncommon for the person attempting to take his own life to first try out the working mechanism of the gun by firing it into some object, such as a bed or a wall, before turning the weapon upon himself. He may even attempt to shoot himself, but in the process his nervous reaction may deflect the shot to some other part of his body, such as the arm or shoulder. This shot is then followed by the actual death shot, either in the chest or in the head. A woman will seldom commit suicide by shooting herself in the head. She will generally bare her chest, place the muzzle of the gun against her breast and pull the trigger.

In one suicide investigated by the author, a woman fired three shots. The first was apparently fired deliberately into the mattress; the second was fired through the left shoulder after she had turned around and had seated herself on the bed; the third shot was a contact wound slightly above the nipple of her left breast. This information was established through the location of directional spurts of blood and through reconstructing the apparent paths traveled by the bullets. The path of the first bullet, which passed through a number of folds in a blanket, definitely showed that she was not seated at the time, as she would then have been in the line of fire. Likewise the second position was established by projecting the line of fire from the bullet imbedded in the wall. After the third shot she fell backwards on the bed, still clutching the gun.

Gunshot wounds in suicide cases are generally contact or near-contact shots, and are accompanied by corresponding powder burns. If the gun is held near the body at the time it is discharged and if the bullet passes through clothing, there will be little or no powder residue on the skin. Clothing should therefore be examined carefully for small flakes of unburned powder; the size of the residue pattern, up to a certain limit, will depend upon the distance the gun was held from the body.

In contact wounds, the tissue will be slightly seared at the point of entrance and particles of unburned powder may be carried into the wound. If the muzzle of the gun is pressed tightly against the body and the bullet passes through clothing, the fibers of the cloth around the hole will also show a seared condition and particles of the cloth may be carried into the wound.

Contact wounds, because of the expansion of gasses, generally cause considerable tearing of the tissue inside the body. If the muzzle of the gun is held in the mouth, a procedure not too uncommon, the force with which the gasses expand may actually tear an opening in the cheek, or force tissue out through the ears, and at times the entire upper portion of the skull may be removed.

Recovering Bullets in Gunshot Wounds

As previously stated, one of the important reasons for the detective being present at the autopsy is to receive first hand the clothing of the deceased and other pieces of physical evidence. If it is a gunshot wound, the investigator should watch the removal of the bullet or bullets, see that they are marked for identification by the autopsy surgeon, then placed in containers for transporting to the laboratory (a small glass bottle with a pledget of cotton in the bottom makes an excellent container). Bullets removed at the time of posting of the body are seldom mutilated by the procedure, as it is possible to make an opening sufficient for their removal. When a victim has been shot and is still living, bullets removed from his body in an emergency operation are often badly scarred and at times many of the identifying characteristics are obliterated by the instrument used during the process of probing and removing them from the wound.

A detective should never carry a bullet loose in his pocket. He may safely wrap it well in a piece of paper and transport it in that manner with little chance of injury. Lead is soft and even the action of clothing rubbing the surface can obliterate the minute striations necessary for comparison.

Hanging

When bodies are found hanging from rafters or beams, and when the act was suicide, the means for reaching that position

Figure 62. Victim committed suicide by placing a muzzle of 30.06 in his mouth. Notice both lobes of the brain are lying intact near the left foot.

will be found in the vicinity. Such objects as chairs, boxes, or ladders, if used to stand on, will generally be tipped over either intentionally or during the death struggle. Sometimes a suicide will tie his own hands together, even behind his back, but the method of tying will differ from that which a murderer would use. The knot will be loosely tied, as it is impossible to cinch the two hands tightly together. He may make a slip knot on each end of a short piece of rope, then, after placing his hands behind his back, slip them through the loops and pull them tight. He may use this as a precaution to prevent him from changing his mind after he has taken the fatal step.

It is not uncommon for a suicide to combine a number of methods, as is illustrated by the following case histories:

Figure 63. Suicide victim used 12 gauge shot gun. He shot himself four times in the chest, pumping a new shell in each time.

A woman about forty-five years of age made deep lacerations across the arteries of each wrist, then walked back and forth through the house until the wounds apparently had stopped bleeding. During her movements through the various rooms she took a long wooden spoon from a drawer in the kitchen. She proceeded to the bathroom· changed into clean clothes, threw the dirty ones in the bathtub, and ran the tub half full of water. She then drank approximately one half ounce of a liquid sedative, part of a bottle of DDT, and almost an ounce of phenol. She got into bed, straightened the clothing very carefully, tied a nylon stocking around her neck—then, placing the wooden spoon in the loop, she used it as a tourniquet to shut off her breathing.

In another case a forty-five year old man severed the arteries in both wrists, walked from the bathroom to the living room, where he took a lather's hatchet from his satchel, returned to the bathroom through the kitchen, turning on all gas jets on the kitchen stove. He then turned both water taps in the bathtub, sat down in the tub and struck himself three times in the forehead with the hatchet; the third blow was of sufficient force to sink the blade into the skull above the right eye.

Suicide, Accident, or Homicide

When called to the scene of a dead body, one of the most important problems confronting the investigator is to establish in his own mind whether the person is a victim of suicide, accident, or homicide. Sometimes, from the very nature of the case, the cause of death is apparent, while at other times it may be difficult to arrive at a definite conclusion, at least until after the body is posted. Careful attention to the position of the victim, the weapon (if present), and the general condition of the scene may supply him with the information he needs.

Gunshot Wounds

When the wound is in the side of the head or in the chest and when the gun is found in the immediate vicinity, suicide is indicated but is not proved. It is possible for a murderer to duplicate any wound made by the suicide. Wounds in the back of the head, back, or wounds made by a gun held at such a distance as to leave no powder residue definitely indicate homicide or accident. When the gun is still gripped tightly in the victim's hand, and when that gun is proved to have been the cause of death, the case is almost certain to be suicide or accident.

The fact that the gun is some distance from the body, or even apparently is not in the vicinity, again may not prove homicide, since suicides have been known to throw the gun from them after the shot is fired. Before jumping to conclusions the investigator should search the entire vicinity thoroughly.

Knife Wounds

Various stab wounds on the front portion of the body can be either homicide or suicide, and when only one wound is present it could be accidental. When a number of wounds are found in

the back there could be little chance of anything but homicide. Cuts in the hands may be the result of the victim grabbing the knife of his assailant during the attack, and would indicate homicide. Bruised knuckles and other indications of physical combat point to homicide. These are only generalities, for the possibilities are so numerous that each case must be studied and evaluated on its own merits.

Marking Evidence in Homicide Cases

Each item of potential evidential value should be marked by the officer or by the article's finder. A small mark, preferably initials, is often used. It is permissible to use some form of a minute hieroglyphic, if the same mark is entered in the officer's notes. This latter type of symbol is recommended in marking bullets, shells, rings, fine watches, et cetera, when it is advisable to use the smallest identifiable mark possible. There is no necessity for mutilating the back of an expensive watch or other piece of jewelry by crudely carving initials in the metal.

Another important point to keep in mind is the necessity of marking the object in such a way as to avoid injuring its evidential value. It is not uncommon for an officer to boldly mark a piece of clothing with his initials, only to find later, when the article is submitted to microscopic examination, that one of the lines has inadvertently transversed a blood spot or some other piece of evidence equally as valuable.

In an important burglary case the evidential value of a button was almost nullified because of careless marking by the officer who found it. The button, with a small piece of brown cloth attached, was torn from the coat of the burglar as he left a building. It was possible later to match the small piece of material with the torn pattern, but great difficulty was encountered in presenting it to the jury, for the officer, in marking it, had used his fountain pen to dye the cloth blue.

It is difficult to set a hard and rigid rule for marking evidence, as circumstances may alter cases, but under normal conditions the following objects should be marked as outlined below:

Coat Mark should be placed on label near inside pocket. No identifying marks should ever be made

on or near the sleeve portions of any clothing. Especially is this true in crimes of violence, for the location of blood spots or smears may be important evidence.

Shirts A shirt should be marked on the tail at the back. Seldom is anything of evidential value found in this locality.

Trousers Trousers should be marked on the inside of the band at the back.

Shoes Shoes should be marked on the inside.

Hat The band inside the hat should be marked on the underneath side, care being taken not to dislodge any hair (if such be present).

Women's Clothing The same general procedure used in marking men's clothing may be applied to those belonging to a woman. Pen and ink should be used when possible.

Bullets A bullet should be marked on the base, keeping the mark as small as possible. It is here that some type of a hieroglyphic may be used to advantage if the same mark is listed in the investigator's notes. It may be necessary to use a mark of this type when a number of bullets are involved in a case, for it would be difficult to put initials and a separate mark on each bullet to differentiate between them. Bullets should never be marked on the nose. To do so may dislodge particles of evidence such as bone, tissue, paint, or blood, dependent upon the substance with which the bullet has come in contact.

Bullets passing through clothing will often have reproduced on their nose an outline of the weave of cloth. This is especially true when the cloth is silk or nylon. In a Bell, California, case the solution was dependent upon the condition of the noses of the bullets involved. A woman had visited her estranged husband. He was in bed, nude, at the time of the visit, while she was fully clothed. An altercation occurred, and they were both found

shot through the groin. The woman stated that the husband had stood in the doorway and, after shooting her, had turned the gun on himself. Both bullets passed through the respective bodies. The one that supposedly had passed through the woman struck a venetian blind near the floor, and came to rest on the carpet. The bullet that had passed through the man traveled to the end of the hall, striking the plaster above the doorway, then fell to the floor. The bullet that passed through the woman came out higher than where it entered, while the exit wound on the man was lower than the entrance wound. These conditions seemed to contradict the woman's story. The author was not called into the case until five days after the shooting. There were no powder burns visible on the man at that time. Examination of the bullets showed that the bullet found on the carpet had on its nose a perfect replica of the weave of the dress worn by the woman, while the other bullet showed no such markings, thus verifying the woman's story.

Shells A shell should be marked on the inside of the open end if it is possible to do so. If the shell is small (such as a 22 caliber), it can be marked on the outside, as near the open end as possible.

Guns It is not necessary to mark a gun if it has a serial number which is readily discernible, but it is still a good practice to note various scratches on the gun butt, trigger guard, or grip, and to enter such information in a notebook.

Knives Knives can be marked on the handle, the mark being scratched with the point of a sharp pen knife.

Tools Tools are usually marked on the handle, or, if it is a bar, on the middle portion, care being taken to avoid the end that may have been used as a pry.

Watches & Jewelry

Care should be taken in marking watches and fine jewelry, to avoid disfiguring them. If there is a number in the watch, it should be copied in the investigator's notebook; any scratch marks visible should also be noted. In marking a ring, a minute mark can be scratched on some specific place on the inside of the band, and this entered in the notes; the exact spot in which the mark was placed should be recorded. An x should never be used, as such a mark is not good identification. This type of mark has been used altogether too much, and its value for identification has become questionable.

Radios, Et cetera

Large objects such as radios, chairs, and so on, may be marked if no serial number exists, or if there are no identifying characteristics peculiar to that object. A cigarette burn, a scratch, a broken portion, are identifiable characteristics.

In a noted California murder trial, keys which could have been of vital importance to the case were found on the suspect. They were excluded as evidence because they had not been marked. Even though they were included in the property of the suspect, no one could positively identify them as being the specific keys which were taken from him.

Small Objects

Small particles of evidence such as weed seeds, dust, dirt and debris, little particles of glass, blood samples, hair, or any evidence so minute in size as to make marking on the object itself impractical, should be placed in small glass vials when it is possible to do so. A stopper should be inserted in the vial and sealed with red sealing wax, the investigator's thumb print being placed in the wax. When evidence of this type is preserved in glass bottles it is possible to make cursory examination and comparison with similar materials without removing them from the container. If glass vials are not available, evidence of the type

described above is placed on a piece of clean white paper, which is then folded into a bindle similar to that used by the drug peddler. Some identification mark is then written on the bindle itself, the bindle is placed in a small envelope, sealed with red sealing wax, and a thumb impressed in the wax. In cases of this type when no wax is available, the bindle is constructed and is placed in an envelope. The envelope is then sealed, and the investigator's full name is written across the flap of the envelope in such a way that various letters of the name will cross and recross the edge of the flap. It would then be difficult to steam the envelope open and reseal it so that the expert could not detect it.

Preservation of Evidence

Frequently in homicide cases some of the evidence is of a perishable nature and may be preserved for court only with some difficulty. Substances that will have a tendency to putrify, such as milk, food stuffs, viscera, et cetera, should be tightly enclosed in glass containers and kept under refrigeration.

Bloodstained articles should be laid out carefully until thoroughly dry before packaging. They should be folded carefully and may then be packed in a carton, each article being separated by a clean piece of wrapping paper.

No two articles that are to be compared for similarity, adhering debris, blood stains, and so on, should ever be packaged in the same container.

Clothes of the suspect and those of the victim must always be placed in separate containers.

In one California murder trial the clothing of the victim was destroyed "because it gave off an offensive odor." A thing like this should never happen. No article directly connected with the body of the deceased and no article belonging to the defendent should ever be destroyed until the case is closed, even though it has no apparent value as evidence. A defense attorney will generally make this an important issue in the case.

Preparing A Case For Court

The homicide officer assigned to the case is directly responsible for the subpoenaing of all witnesses and for systematically presenting his case in court. It is his responsibility to see that the chain of continuity of each piece of physical evidence is complete; that the finder of such evidence and any other person through whose hands it has passed are present when the case comes to trial. One exception to this rule would be when evidence had been in a sealed package and had reposed for some time in the office of the property clerk. The chain of continuity in this case would automatically be complete from the time it was sealed until that seal was broken. Far too often vital pieces of evidence have been inadmissible in court because the chain of continuity was not completely accounted for.

It is also the duty of the investigating officer to summarize his case, listing the various pieces of physical evidence and what

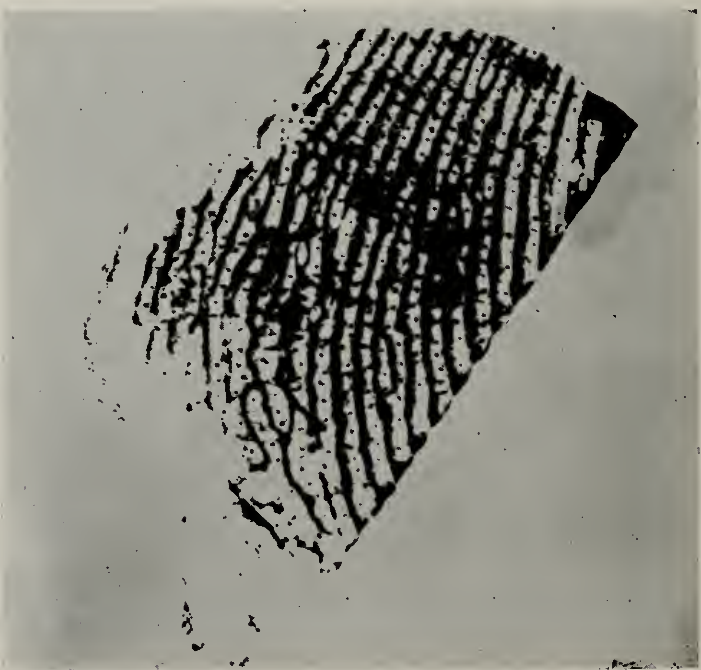


Figure 64. A small piece of skin found adhering to cap of suspect in a murder case.

Figure 65. Photo of index finger of victim.

analysis and findings have been made of each. He should have a short brief of the expected testimony of each witness subpoenaed. He should see that such documents as proof of ownership of car, proof of prior record of the defendent, and so on, are brought to court.

It is also his duty, after gathering all such information and evidence, to discuss the case with the prosecuting attorney, to lay all this information before him, and to acquaint him with

Figure 66. Shows Illustration 64 superimposed over Illustration 65. Notice contour pattern and matching of ridges.

any other information that he has, even though it will not be admissible in court. This will enable the prosecutor to get a comprehensive picture of the case he is going to try.

This type of procedure, of course, is not confined to homicides alone, but to any investigation. No prosecutor can successfully handle a prosecution and present a case in court unless he has all of the available facts. Cases have been lost unnecessarily

because certain information brought out by the defense in the trial came as a complete surprise to the prosecutor. If he had been apprised of this information prior to the trial he might actually have been able to have used it to his own advantage.

Figure 67. Mark on forehead of murder victim identified as having been made with heavy glass ash tray.

XI

BLOOD ANALYSIS

Blood analysis plays an important part in most homicide and assault cases. It often becomes an important issue in such crimes as rape, burglary, or robbery.

Because of the complexity of the subject, the investigator should not only know the possibilities of blood analysis, but should also be aware of its limitations. Few analyses pertaining to the human body are simple processes, and blood analysis is no exception. There are many good treatises on the subject, yet a correlation of this information, bringing together the pertinent facts, can be valuable to the investigator.

Functions of the Blood

The blood coursing through the veins and arteries of the body performs seven important functions:

1. It carries oxygen from the lungs to the tissues.
2. It carries carbon dioxide gas from the tissues to the lungs.
3. It carries food from the digestive tract to the tissues.
4. It carries waste from the tissues to the kidneys, et cetera, for elimination.
5. The white corpuscles act as a defense mechanism.
6. It maintains body temperature.
7. It regulates the pH, in other words, it regulates the acidity or alkalinity of the body.

Volume of Blood in the Body

Various authors have conflicting opinions as to the amount of blood in a human body. These opinions vary from about .10 to .05 of the body weight. Sometimes authors are talking about different things—one may mean complete exsanguination of a body, when all the blood is permitted to drain out. Sidney Smith, in *Forensic Medicine,* estimates that about .0625 to .05 of the

body weight is blood. In all probability he is not including that portion of the blood which is captured and held by the myriads of minute capillaries in the tissue. Bodanski, after summing up this information as set forth by various authorities, concludes that the volume of blood in the human body represents between one-eleventh and one-twelfth of the body weight. Thus. a two hundred pound man would have about eighteen pounds of blood, if it were possible to withdraw it all.

Blood Composition

Blood has the following component parts:

1. Erythrocytes—or the red blood cells.
2. Leukocytes—white blood cells.
3. Blood platelets—a cell related to blood clotting.

The above group of cells represent about 40 to 45% of the total volume of the blood. The rest is plasma.

Red Cells — Erythrocytes

A normal, healthy male has approximately five million red blood cells per cubic milliliter of blood. The average diameter of the red blood cell is about 8.8 micra* (they range from 7.5 to 9.5 micra). The volume of a red blood cell is about eighty-five cubic micra. The normal destruction of red cells in the human body is about ten billion per hour. When red blood cells are exposed to air one of two things may happen: (1) the outer membrane may break, releasing the hemoglobin (this is known as haemolysis); (2) the cell may be dehydrated, resulting in a wrinkled appearance (this is crenation).

White Cells — Leukocytes

There are a number of different types of white blood cells, or corpuscles, such as lymphocytes, monocytes, granulocytes, et cetera, and their primary function it to create a defense mechanism in the body. The normal count of white cells ranges between five thousand and ten thousand per cubic milliliter of blood. They do not enter into blood analysis as performed in the crime laboratory but are simply given here to show the complexity of blood.

---

*One micron equals 1/25,400 inches.

Platelets

Platelets are classed as one of the elements of the blood whose function is closely related to blood clotting. There are from 250,000 to 400,000 blood platelets per cubic milliliter.

Plasma

Plasma is blood minus the cells. It is the carrying medium that transports the cells from the lungs to the tissues, and from the tissues back to the lungs.

Serum

Serum is blood minus cells and fibrinogen. Fibrinogen is a soluble protein in the blood. When blood clots, fibrinogen changes into the insoluble protein, fibrin. This process requires calcium, thus if calcium is removed by some such material as an oxalate or a citrate, blood will not clot. Serum may be prepared by centrifuging or by allowing the blood to stand and then decanting. Serum, and not plasma, is used for human blood analysis and blood typing. Serum is between ninety and ninety-two percent water.

Hemoglobin

Hemoglobin is the colored matter contained in red corpuscles. It is a complex organic substance.

Comparison of Blood from Different Species

All mammalian animals (animals who suckle their young) have circular non-nucleated corpuscles. There is one exception to this rule, which is the camel family (camels, dromedary, alpaca, vicuna). This group has oval, nucleated corpuscles.

All birds, amphibian, reptiles, and all fishes, except the lamprey, have oval, nucleated red corpuscles. Birds, fish, and reptiles generally have a larger corpuscle than those of animals.

The corpuscle of a human being is larger than most domestic animals, except the dog, whose corpuscle closely approximates that of the human.

The foregoing material is given in order to emphasize the complexities of the circulatory system of mammals. The investigator may readily see that blood analysis is no simple process.

Bloodstains

Often bloodstains, because of locality and directional outline, may be of utmost value in proving a case. For instance, the defendant may state that the blood on his clothes came from a nosebleed, yet if it can be shown by the location of spurts of blood and by their direction of travel on such portions of the garment as the back of the collar, the back portions of the coat, the elbow, et cetera, that these blood spots came from a foreign origin, then the defendant's allegation can be proved false.

Droplets of blood striking a wall or floor will leave a characteristic pattern which will indicate the direction in which they were traveling. If a sufficient number of drops can be located and lines projected through their directional axis, the converging point of these lines will indicate roughly their point of origin. In a certain homicide where a man killed his wife, he claimed self-defense, stating she attacked him with a butcher knife and to protect himself he struck her with a tire iron, but the blood pattern on the wall indicated the point of origin to be approximately eighteen inches above the floor, showing that she was down at the time the blow was struck. This completely disproved the man's self-defense alibi.

It is not always possible to distinguish between arterial and veinous blood through observation of the pattern, although frequently blood from the veins may result in myriads of fine droplets because of the minute size of the vein openings. If an artery is severed the blood gushes forth more violently and has a tendency to leave larger droplets, yet either pattern may be similated where numerous blows are struck and the pattern results from the splashing effect caused by the weapon.

Walking Pattern

A careful study of droplets of blood on a sidewalk or floor may indicate the direction the injured person was traveling; these spots, however, can be very deceptive. It may also be possible to ascertain that portion of the body injured through a study of the blood distribution along the path traveled, but again this can be deceptive. One must not jump to conclusions. In one case

a suspect was trailed more than two and a half miles by following drops of blood on the sidewalk, all of which were on the extreme left hand edge of the walk. If one were to think hastily, he might conclude that the victim was injured somewhere on the left side. This was proved false when he was arrested, as the blood was found to have come from his right wrist. Throughout the entire trip he had carried the right arm suspended across his body, thus allowing blood to fall on his left side.

Color of Blood

Fresh blood is bright red, and gradually turns darker upon exposure to air. Blood subjected to sunlight will turn dark brown, sometimes almost black. For this reason it is difficult to estimate its age. Blood on wallpaper may have a greenish appearance, probably due to the dyes in the paper. Damp objects from which blood has apparently been removed by washing will often have a pale green appearance.

Other Stains That Appear Like Blood

Bloodstained objects, when found at the scene, should be

Many substances have the appearance of blood, especially to the untrained eye, and when such are found they must be eliminated by chemical tests. Some substances that may appear as blood are (1) vegetable juices, (2) fruit juices, (3) paint, (4) coffee, (5) sealing wax, (6) iodine, (7) lipstick, (8) nail polish, (9) shoe polish, (10) various dyes, (11) medicines, (12) rust. Rust, when viewed through a microscope, may appear very deceptive even to the trained expert. It has the same glossy appearance as blood itself.

Removal and Preservation

transported to the laboratory for analysis whenever it is possible to do so. Even such large objects as kitchen tables, radios, chairs, rugs, et cetera, have been taken to the laboratory for analysis and have later been entered as exhibits in court. Such a procedure permits the jury to see for themselves that blood does exist, and that it is on these objects, as testified to. If one is unable to move the article to the laboratory, the blood should be thoroughly dried and then carefully flaked off and preserved in a glass vial,

preferably by a laboratory expert. If one is unable to obtain a glass container, he should place the blood in a clean piece of paper, fold carefully, then seal in an envelope. One should never scrape blood directly into an envelope, as it is difficult to remove for analysis.

Wet or blood soaked objects, should be dried before packaging, as otherwise putrification may result. Preservatives, such as oxalic acid or citrates should not be used, as they may hinder later analysis.

Bloodstained Clothing

Bloodstained clothing should first be thoroughly dried, then folded in such a way as to prevent the stained portions from coming into contact with the non-stained portions of the garment. Pieces of wrapping paper or clean white paper may be used for this purpose. This procedure will aid in preserving blood spurts that may be directional in nature and of value in later analysis. All such articles of clothing should be wrapped separately. Only as a last resort should a blood stain be dampened with a saline solution as a means of removing it. Other substances might be dissolved that would contaminate the stain.

Removal of Bloodstains from a Human Body

. When blood is found on the body of a suspect (especially in such places as between the fingers, or on the genital organs) and it is necessary to remove it for analysis, the following procedure is found to be satisfactory:

> Saturate a clean piece of white blotting paper or a small pledget of cotton with saline solution (0.85% sodium chloride in distilled water) and touch the material to the contaminated portion of the body, then place on a white piece of wax paper or in an open glass container and allow to dry. After the material is thoroughly dry it may then be packaged for the laboratory.

Chemical Examination of Bloodstains

There are four distinct steps in blood analysis, all of which may be necessary under certain conditions. These steps are:

1. *Preliminary Tests*
   These tests indicate that the material may be blood, but do not identify it definitely as such. These are good elimination tests, in that a *negative* result rules out the substance as blood.
2. *Confirmatory Tests*
   These tests prove the substance to be blood, but do not identify the species.
3. *Biological Precipitin Tests*
   These tests identify the species, such as human, canine, bovine, et cetera.
4. *Blood Grouping*
   Blood grouping identifies human blood as falling into one of a number of classifications.

PRELIMINARY TESTS

There are a number of preliminary tests which will be taken up individually, describing the method of procedure, limitations and value of each. These tests do not prove the substance to be blood, but are excellent eliminative tests that can be used to advantage in the field. If the reaction is negative the substance is not blood, and may be eliminated, thus making it necessary to take to the laboratory only those objects or that substance which the tests indicate could be blood. The expert, thoroughly familiar with these tests, can save time and unnecessary work by using them to advantage as his examination proceeds.

The type of test used will depend upon the investigator and his opinion as to their degrees of efficiency. The various preliminary tests have been evaluated, and are discussed below in the order of their merit:

Benzidine Test

The benzidine test has been chosen as the most efficient for a number of reasons: (1) the ease with which it may be used, (2) its sensitivity (not too sensitive—1 part in 300,000—yet sensitive enough to do the work, (3) the fact that it does not react to such substances as iron salts, mucous, semen, sputum, most vegetable or fruit juices, and reacts only sluggishly to lead salts.

Benzidine Reagent — How to Prepare

To approximately 2 ml. of glacial acetic acid add sufficient benzidine base (paradiamino-diphenyl) to make a saturated solution. To this add 2 ml. of hydrogen peroxide. The resulting solution should have a straw-like appearance, and should be made up fresh immediately before use.

Various Methods of Applying Tests

The following common method may be used where the material can be flaked off and small particles dropped into the cups of a spot plate, containing the above reagent. If the reagent is strong and in good condition the resulting color reaction will be a deep blue. Weak reagents or reagents containing a poor grade of hydrogen peroxide will show a greenish reaction. Articles of clothing having stains which are to be tested for blood may be held carefully over one of the cups of the spot plate and a small portion of the stain scraped into the cup. When the stains have been partially removed by washing, a small piece of the cloth should be cut out with a pair of shears for the test. When the directional pattern has value to the case, it is essential that the tests do not measurably alter this pattern in any way. This may be accomplished by dipping a stylus in a saline solution, touching it to the stain and then to the benzedine reagent, noting the color reaction.

Clothes which have recently been washed in a strong bleaching agent may give a positive reaction to the benzidine test.* If it is suspected that such is the case, a test should be run with a piece of the cloth, using the benzidine reagent before the hydrogen peroxide has been added. Clorox and a number of other such bleaching agents will give a positive reaction even before the addition of hydrogen peroxide. Blood will not.

When a suspect has had blood on his body, even though he has attempted to remove it by washing, it will often show a positive reaction to the benzidine test. A method of application which gives excellent psychological results is as follows: holding a small pledget of cotton with tweezers, dip it in benzidine reagent and

*In a recent test, two pieces of cloth were soaked in straight Clorox, one allowed to drip-dry, the other thoroughly rinsed and drip-dried. Twenty-four hours later, both gave negative reactions to the Benzidine Test.

then touch to the possible contaminated area, allowing the suspect to watch the color change. Numerous times this procedure has resulted in a full confession. Each application to the body should be wiped off afterwards with a damp cloth, as glacial acetic acid has a dehydrating effect on the skin.

Blood Removed by Washing

It is almost impossible to remove blood from a garment by washing. In actual tests a blanket previously saturated with blood was subjected to seven distinct and separate launderings and yet gave a positive reaction to the benzidine test. A blood-soaked article was boiled for one hour, yet gave a positive reaction with the benzidine test. A twenty year old bloodstain gave a positive reaction. A six year old bloodstain on a rusty iron bar gave a positive reaction. When blood has soaked into dirt the reaction may be slow, but can be hastened by adding a drop of pyridine.

Blood subjected to the benzidine test should react within five seconds. If the reaction is very slow and sluggish it should be considered negative. Some clothing, evidence in a thirty-four year old murder case, was given the benzidine test and, although the bloodstain had almost faded away, it gave a strong positive reaction.

Leuco Malachite Green Test

This preliminary test is more sensitive than the benzidine test, giving a positive with 1 part in 450,000, which may or may not be an advantage. Extreme sensitivity often results in positive reactions on a more diversified field of substances. This test also has another disadvantage, which must be considered of primary importance, in that it reacts with iron salts. Many instruments used in homicides, et cetera, are made of iron and are often incrusted with rust (iron oxide). For example rusty guns, iron bars, tire irons, pipes, knives, and wrenches, all of which are common weapons used in crimes of violence.

Reagent

Leuco Malachite green powder	1 gram
Glacial Acetic Acid	100 ml.
Distilled water	150 ml.

This is a stock solution and if kept tightly corked will remain

in good condition for a number of days. When it is to be used the above stock solution is diluted 4 to 1 with hydrogen peroxide. When this reagent is used the procedure for analysis is the same as described in the paragraph under benzidine test. The color reaction is a bluish-green.

Phenolphthalin Test (Kastle-Meyer)

This test is extremely sensitive, and some authorities claim that blood will react in a dilution of one part in 5,000,000. It can readily be seen that a test with such sensitivity would have a tendency to react with many substances.

Stock Solution (Preparation)

Dissolve 1 gram of phenolphthalin in 50 ml. of 20% potassium hydroxide solution. Add approximately 1 gram (more if necessary to decolorize) of zinc dust, and boil until the solution is entirely colorless, replacing the water lost by evaporation. Filter and cork tightly. This stock solution will last several weeks.

To make up the reagent 1 ml. of the above stock solution is diluted with 9 ml. of boiled distilled water, and 1 ml. of 17 volume hydrogen peroxide is added. Analysis same as described in the benzidine test. Color reaction—a bright rose pink.

Guaiac Acid Test

This test is not as sensitive as others, giving a reaction to about 1 part in 50,000. It has another disadvantage of far greater importance in forensic work in that the following articles give a positive reaction with this reagent: iron salts, cheese, milk, potatoes, perspiration, pus, and many other organic substances. It is obvious why it is regarded as the least valuable of all the preliminary tests.

Guaiac Acid Reagent

Make a saturated solution of guaiac resin in alcohol or pyridine. To this add a few drops of old turpentine. Color—blue.

CONFIRMATORY TESTS FOR BLOOD

A confirmatory test proves the substance in question to be blood. It does not identify the species. In cases in which there is a preponderance of evidence, this may be sufficient. For ex-

ample, if, in a murder case, the room, hallway, stairs, entrance, et cetera, were spattered with blood the following procedure would probably suffice: identify as to type of blood with one sampling; identify a portion of the blood in each of the places named as human blood; identify various blood patterns on walls, doors, et cetera, only as blood. This would determine the general origin of the substance as to species and type and it could be assumed that various stains in the immediate vicinity, if proved to be blood, had the same origin.

Microscopic Test

The microscopic test, wherein corpuscular bodies are found, is the simplest and easiest confirmatory test to perform. A small piece of the material at the outer edge of a stain should be selected for examination. Here the blood has dried more rapidly with a resultant crenated corpuscular condition. The material should be placed on a slide and viewed through a microscope at about two hundred diameters. If corpuscular bodies are present, the grape-like appearance will be noted. No other substance having corpuscular bodies gives a positive reaction to the benzidine test. This condition will be found to be present only if the red corpuscles have not hemolized.

Teischman or Hemin Chloride Crystal Test

Where the red corpuscles have hemolized no identification can be made with a microscope, thus making it necessary to resort to a chemical test. The hemin chloride crystal test is excellent for this purpose as it is not dependent upon the corpuscles themselves but upon their content, (hemoglobin).

The procedure for this test is as follows:

> Place a small piece of the suspected material on a microscope slide; add 1 drop of saline solution (0.85% NaCl in distilled water); allow to stand for about 30 minutes, then evaporate to dryness; place cover slip over substance. With eye dropper float a drop of glacial acetic acid under the cover slip, allow to stand for 2 or 3 minutes, then again evaporate carefully to dryness. Do not subject it to a temperature gereater than about 60° C. as glacial acetic acid is quite volatile. This temperature may be approximated if the slide can be touched to the back of the hand

without burning. Repeat the process, adding another drop of the acid. Then examine the slide under a microscope at about 150 diameters. If the substance is blood, brown rhombic hemin chloride crystals will be found.

Beam and Freak Test

The Beam and Freak test is a variation of the Teischman test, but necessitates a greater amount of the suspected material.

Method:

Place a piece of the suspected material in a small test tube; add 4 drops of saline solution. Allow substance to dissolve, then evaporate to dryness. Add 1 ml. of glacial acetic acid. Insert a white cotton thread of sufficient length to reach the bottom of the tube, and extend about an inch out of the top. Let stand overnight. The piece of string will act as a wick, gradually drawing the solution from the tube. Rhombic hemin chloride crystals will form along this thread. This test has one advantage in that the crystals are larger, and often may be plainly recognizable macroscopically.

Spectroscopic Test for Blood

The spectroscopic test is dependent upon the fact that the pigment of the blood has a tendency to absorb the light of specific wave lengths, thus if a solution containing blood is observed by means of a spectroscope, absorption bands blocking out different parts of the spectrum may be noted. The reaction of certain reagents upon a sample of blood will give a different absorption pattern for each. These various patterns are given by no other form of pigmented material, and thus may be used as a conclusive test for blood.

The procedure follows:

Remove a portion of the stain and place in a watch glass. Add a few drops of distilled water, cover, and allow time for the material to extract. Filter the solution into a small test tube and then examine through a hand spectroscope. Adjust spectroscope until the Fraunhofer lines are sharp and distinct, then insert the test tube between the instrument and source of light. The two absorption bands that will be seen between the D & E lines of the solar spectrum will identify the material as oxyhemoglobin. The

first line commences at the D line and is the darker of the two. The second band extends slightly beyond the E line but is less clearly defined. Ammonium sulphide will reduce oxyhemoglobin to hemoglobin, resulting in a different absorption pattern. Through various methods hemochromogen, methemoglobin, sulph-methemoglobin, or hematin may be formed, each with a distinct absorption pattern. Carbon monoxide hemoglobin also has an identifiable pattern with a spectroscope.

BIOLOGICAL PRECIPITIN TESTS

The third step in blood analysis is to determine the origin of the unknown blood as to species—human, canine, bovine, avian, feline, et cetera. This may be determined by performing the Biological Precipitin test using the specific antiserum for the suspected species. For example: to identify a stain as human blood, anti-human serum is used; if it is bovine blood one uses anti-bovine serum, et cetera. Anti-human serum is commonly prepared in the following manner: two cubic milliliters of human serum are injected into the outer vein of the ear of a rabbit; this is repeated two or three times at five day intervals. Ten days or two weeks after the last injection a small amount of blood is drawn from the rabbit and is tested as to its titre or strength. It should react with known human blood having a dilution of 1:1000. The blood is diluted with saline solution (0.85% NaCl in distilled water). A 1:1000 dilution may be determined by shaking the tube. If the mixture is less than this dilution, foam will persist for a minute or more. The author prefers to work with a serum of a higher titre—1:2000 or even 1:3000. If a higher titre is used the chance of it reacting with nonspecific blood is lessened. When the blood of the rabbit has reached a satisfactory titre the rabbit is bled aseptically and the serum separated by means of a centrifuge. The serum is sealed in a sterilized container and is kept under refrigeration. The test is run as follows:

A one-fourth inch piece of impregnated cloth is placed in a small test tube and two or three drops of saline added. It is corked and is then set in the refrigerator for twenty-four hours to extract. If it is not allowed to extract sufficiently a false reaction may result. The following test tubes are now set up:

No. 1—1:2000 dilution of unknown blood
No. 2—1:2000 dilution of known human blood

No. 3—Saline solution from stock

No. 4—Extract from uncontaminated part of fabric

No. 5—1:2000 dilution of unknown blood

To numbers one, two, three, and four introduce, by means of a hypodermic syringe, one milliliter of anti-human serum, being sure that it is placed in a layer at the bottom of the tube. This serum should have a titre of not less than 1:2500.

To number five, using the same method, add one millileter of normal rabbit serum. Place the five tubes in a water bath having a temperature of 37.5° centigrade. Take a reading in twenty minutes. A positive is a thin cloudy appearance at the juncture of the two liquids. Additional tubes may be added, each having a 1:2000 dilution of blood from other contaminated areas.

Also tubes containing 1:2000 dilution of various animal bloods may be run at the same time if the circumstances of the case would tend to make analysis of such blood an issue.

This procedure as outlined may prove the following: (1) That the unknown blood *is* of human origin. (2) That known human blood *will react* with the anti-human serum being used. (3) That the stock saline solution *is not contaminated* with human blood. (5) That normal rabbit serum *will not react* with the unknown blood in question.

BLOOD GROUPING

The fourth step in blood analysis is that of blood grouping. This step may or may not be of value to the case, depending upon the results of the analysis. It is a good negative but a poor positive test. In other words, if the blood found on the clothing of a suspect is of a different group than that of the victim the blood on the clothing *did not* come from that source. If they have the same blood group, the blood *could* have come from the same or other sources.

There are four major blood groups, O, A, B, and AB, which, in the white race, are distributed approximately as follows: O, forty-five per cent; A, forty per cent; B, nine per cent; and AB, six per cent. The author found that the blood groups of four thousand two hundred Los Angeles police officers were as follows: O, forty-three per cent; A, forty-two per cent; B, eight per cent; and AB, seven per cent. Blood may be further grouped, using M, N, and MN classification, also Rh positive and Rh

negative, but these sub-classifications are not feasible with dried blood. The phenomena of blood grouping is based upon agglutination or clumping of the erythrocytes, or red blood cells. There are two specific agglutinable substances known as agglutinogen "A" and agglutinogen "B." In the human race either or both may be present in the red cells or they both may be absent, thus giving rise to the four groups. The blood serum contains anti-bodies known as anti "A" and anti "B." Again, either or both may be found, or again, they may both be absent. These anti-bodies are sometimes referred to as agglutinin "a" and agglutinin "b." Thus the agglutinable components of the primary classification may be set up as follows:

Group	*Corpuscles*	*Serum*
O	Neither "A" nor "B"	"a" and "b"
A	"A"	"b"
B	"B"	"a"
AB	"A" and "B"	Neither "a" nor "b"

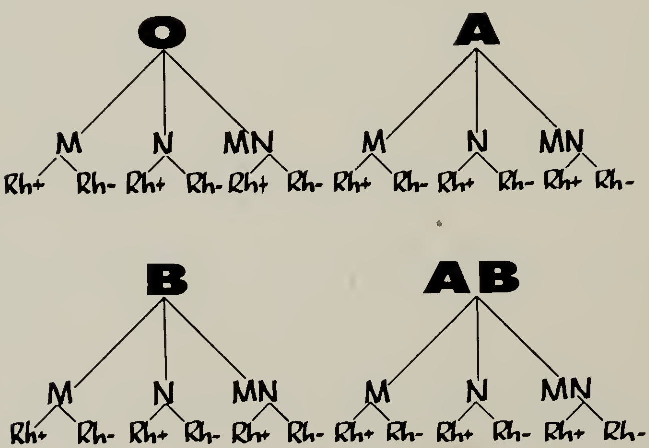


Figure 68. Diagram of possible blood groups using fresh blood. It is not complete as it does not take into account A_1 and A_2 nor extensions of the Rh factor.

It may be noted that agglutinin anti "A" ("a") never occurs in conjunction with agglutinogen "A" nor does agglutinin anti "B" ("b") ever occur with agglutinogen "B."

In fresh blood having the red corpuscles intact, primary blood grouping is more or less a simple process. This is not always true with a dried stain. The agglutinins in the serum may break down

and their potency disappear completely within a few weeks or, if the blood putrifies, even in a few days. If this takes place one cannot definitely identify type O.

The identification of types "A," "B," and "AB" may still be accomplished through what is known as the indirect method. The agglutinogens persist for some time, often as long as a year or more. For methods of analysis see *Blood Grouping*, by Weiner.

In paternity cases, blood grouping is an excellent negative but a poor positive test. All that may be said if the test is positive is that the man *could* have been the father.

PATERNITY

Parents	*Could Have Children of Type*	*Could Not Have Children of Type*
O x O	O	A, B, AB
O x A	O, A	B, AB
O x B	O, B	A, AB
O x AB	A, B	O, AB
A x A	O, A	B, AB
A x B	O, A, B, AB	—
A x AB	A, B, AB	O
B x B	O, B	A, AB
B x AB	A, B, AB	O
AB x AB	A, B, AB	O

Laboratory Examination of Various Articles for Blood

Clothing

To examine clothing, this procedure should be followed: the garment should be spread out on a table and gone over systematically, starting with a sleeve of a coat at the cuff, and the entire front portion of the garment examined; the size and shape of each bloodstain should be noted. Each stain should be encircled for future analysis. The garment should then be turned over and the same procedure followed on the opposite side.

Some specifically important places to look for blood on clothing are: inside of cuffs of shirt or coat; inside of bottom of trouser legs; pockets of clothing, especially rear trouser pockets where handkerchief is kept; inside and outside of fly of trousers; in the small cuplike ornamental portions on toes of shoes. The soles of shoes should be inspected and tests carefully run on the thread portion of the sewing. The thread is absorbent and will often retain blood when no other part of the shoe will.

If the stains have directional value, they should be photo-

graphed before proceeding with any chemical analysis that may alter their appearance. After all the garments have been examined microscopically, it is a good procedure to examine a number of the stains through a low powered, wide field, stereoscopic microscope for foreign material, such as nasal hairs, genital hairs, pus, skin tissue, globules of fat, et cetera. If such material is found, and after photographing, the stain should be carefully removed for a study under higher magnification. During the examination, size and shape of the stains should be noted, and such information entered in the report. Any portion of bloodstained clothing that has been partially laundered will give a positive reaction for blood.

OTHER ARTICLES

Guns

All visible portions of a gun should be gone over with a low-powered microscope, especially the knurled portions of the grips, the sights, trigger guard, et cetera. If no blood is found, the grips should be removed. Even after a gun has been washed, blood may be found here. The investigator should not be misled by rust, as its appearance, even microscopically, can be mistaken for blood.

Knives

Each blade of a knife should be carefully examined under the microscope. If the knife has been used in a stabbing, small globules of fat tissue may be seen adhering to the surface of the blade, and by noting their extent up the blade, a conclusion may be reached as to the depth the knife was inserted. This can be of vital importance as evidence if the autopsy verifies this fact.

XII

SEXUAL ATTACK CASES

Rape, whether it be statutory or by force, theoretically may be proven by the testimony of the victim alone, but this is not always true. Many times defense attorneys will harass the victim and will do everything in their power to embarrass her. For that reason, physical evidence in rape cases often becomes of prime importance and many times may actually prove a case. This is especially true when the victim is too young to give accurate testimony. Systematic gathering of evidence has aided in the solution and successful prosecution of many such cases.

Clothes from a rape victim should be removed as soon as practical, and should be folded carefully, each article separated by sheets of paper, then bundled for presentation to the laboratory. If the clothes are wet or have fresh seminal stains on them, they should be thoroughly dried before packaging, as otherwise there may be a tendency for them to mold or putrify. Each article should be marked, care, as usual, being taken that no mark is placed on any portion of the garment where there is a possibility of destroying evidence. The male organism is easily destroyed and its presence is positive identification of a seminal stain. It is also important that adhering debris such as weed seeds, hair, fibres, paint, and dirt be preserved as potential physical evidence to verify the victim's statement that she was in some specific place or came in contact with some specific object.

It is also essential that a similar procedure be followed with respect to the clothing of a suspect. Never, under any circumstances, should a suspect or victim be permitted to return to the scene of the crime wearing clothes which may be pertinent to the case.

Any suspected car should be immediately impounded for examination by the laboratory.

Interviewing the Victim

Systematically interviewing a rape victim is of prime im-

portance and should be done by a police woman or at least in her presence. It may be difficult to obtain accurate information from a young girl in her teens in the presence of parents, as she often will be too embarrassed to state the facts. Systematic notes should be taken throughout the interrogation.

Below is a list of some of the information that should be obtained:

1. Where and when did she first meet the party on the day in question?
2. Was she previously acquainted with him? Failure to get this information may weaken the case if it is brought out by the defense that she previously knew the suspect, or had been in his presence at other times; yet if such information is known to the prosecutor he may actually use it to an advantage in his prosecution.
3. Detailed description of force used. This is important especially when the case is rape by force or fear, as it is part of the *corpus delecti*. The victim should be asked to describe in detail the entire act from the beginning to its consummation.
4. She should be questioned as to her physical condition, whether or not she was menstruating; what articles of clothing she had on at the time, and whether they were removed by her or by the suspect.
5. A detailed description of the route traveled and the location where the act took place—a car, house, et cetera—should be obtained.
6. The girl should be allowed to tell her own story. Words should not be put into her mouth. This latter is especially true with small children who are susceptible to suggestion. If the victim is going over the scene, step by step, she should be allowed to state what was done, what was said, et cetera. She should be asked such questions as "What did he do next?" "What did you do?" or a similar form of interrogation. If one tries to portray to a small child certain acts supposedly done by the accused she will generally agree, even though the statement is inaccurate.

Interviewing the Suspect

A statement should be taken from a suspect as soon as it is possible to do so. He should not be given time to think up various alibis or excuses. He should be asked to give a detailed account

of his movements, not only of the time allegedly spent with the victim but what he did prior to and after this period. He may deny having seen the victim or even having been in the same locality, but his statement should be taken nevertheless. If he is lying, a careful check of his story may prove the falseness of his statement.

Examining Clothes in the Laboratory

1. The victim's clothing should be examined systematically for debris, such as weed seeds, weed pods, and grasses; all such evidence should be preserved in glass vials.
2. Each individual piece of clothing should be examined for tears, missing buttons, grass stains, and bloodstains. Findings should be photographed and recorded.
3. Each piece of clothing should be submitted to an examination under ultra violet light as a means of discovering possible seminal stains. A seminal stain when dry feels starchy to the fingers, and floresces bluish-white under ultra violet. Positive identification of a seminal stain can by no means be made in this manner, as mucous from the nose and other orifices of the body may floresce similarly. Seminal stains on black clothing at times do not floresce and must be located through feel alone. Seminal stains may often be found on the inside of the coat, dress, or slip at the back, dependent upon the derangement of clothing during the act of intercourse. Seminal stains may also be found on girdles, panties, garter belts, stockings, handkerchiefs, et cetera.

Finding a seminal stain tends to verify the victim's allegation that an act actually did take place, yet the absence of such a stain is not a negative proof.

Where no spermatozoa are present, a seminal stain may still be identified as such through the use of the acid-phosphatase test.

Suspect's Clothing

The suspect's clothing should also be examined systematically for adhering debris, tears, missing buttons, et cetera. The condition of the fly portion of the trousers and underwear should be noted and the area examined for blood and seminal stains.

Person of Suspect

After the suspect carefully removes his clothes, his body should be examined for bites or scratch marks, and his genital organs for blood and foreign pubic hair. If the victim was known to have been torn or menstruating, blood may be apparent around the genital organs. The fact that no blood is visible does not necessarily eliminate the susupect. He may have washed subsequent to the act. Even though he has tried to cleanse himself by washing, the benzedine test may indicate the presence of blood. If this test is positive, it may have a strong psychological effect on the suspect.

The suspect's fingernails should be carefully trimmed, and the trimmings placed in a small glass vial, keeping those from each hand separate. This method is superior to cleaning the nails, as the debris is left more or less intact and may be examined microscopically with greater accuracy. The debris adhering to the fingernails may show such important types of physical evidence as fibers from the victim's clothing, small particles of blood, or even pubic hairs. That portion of the fingers around the base of the nail should also be examined for blood, using the same technique as previously described.

During the struggle at the time of the attack the victim's fingernails may have been broken. If a foreign piece of nail is found in the debris from the clothes of the defendant, it may possibly be identified as having come from the victim through comparison of the small longitudinal ridges found on the nail surface or by the contour pattern of the torn edge.

Person of Victim

The person of the victim should be carefully examined by a policewoman and notes made of any scratches and bruises. Bruises may be more apparent twenty-four hours after the attack. The victim's fingernails should be cleaned (most women object to having their fingernails clipped) and the debris examined under a microscope. Photographs should be made of all bruises or scratch marks on the bodies of both the victim and the suspect. This is one time when color photography is of great value to the case.

Spermatozoa

The male reproductive cell is the spermatozoon (plural, "spermatozoa"). It is a one-celled organism similar in shape to a tadpole. It is about .05 mm or 1/500 inch in length. It has an eliptical head and a rod-shaped middle section, to which is attached a tail. The head and neck constitute about one-fifth of the total length of the organism. The head is the nucleus of the cell. There are many shapes and sizes of male organisms in the various animals and birds. Certain insects may have spermatozoa larger than that of the human, while the spermatozoon of a whale is smaller. The spermatozoa of the dog and cat are similar in appearance and approximately the same size of those of the human, yet they appear sufficiently different microscopically to allow differentiation.

The Ovum

The ovum (plural, "ova") is the female organism. It is globular and is about four times as large as a spermatozoon. It is approximately 2/10 mm, or 1/125 inch in diameter. It is rare indeed to find an ovum in a vaginal smear.

Other Particles Sometimes Found in the Vaginal Tract

1. Trichomonads are small, flagelated, pear-shaped organisms about four times the size of a spermatozoon.
2. Squamous epithelium cells are flat, scale-like objects found in all secretions from the vagina. They are also present in other orifices of the body. They have a nucleus which, when stained, closely resembles the head of the human spermatozoon, and if the expert is not familiar with the appearance of each he may confuse the two.
3. Ciliated epithelium cells are also found in the vaginal tract. They are flagelated and the small appendages when broken off may be mistaken for the tails of spermatozoa.

Procedure for Identifying the Seminal Stain

1. Locate the suspected seminal stain through the use of the ultra violet light and the feel of the fabric.
2. Encircle stain with pencil, pen, or chalk.

3. Cut out a small piece of the cloth, place on microscope slide.
4. Dampen cloth with one drop of distilled water or saline solution, and allow to stand for about thirty minutes.
5. Using a pair of tweezers and a stylus, gently press the moisture from the piece of cloth, distributing it evenly over an area on the slide about one-fourth inch in diameter; then remove the cloth.
6. Dry the slide carefully over a flame: do not allow it to reach a temperature in excess of 60° Centigrade. The temperature may be tested by touching the slide with the back of the hand. It should not be hot enough to burn the skin. This procedure "sets" the stain on the slide.
7. Cover the slide with methyl blue stain, and allow to stand for one minute. Wash carefully with distilled water, and dry as before.
8. Examine under the microscope at from 150 to 300 diameters.

For a visual identification of a seminal stain, the spermatazoon should be found intact, i.e., the tail and head must be joined together. If the expert endeavors to identify the separate parts he may mistakenly report the stain positive when actually he saw the mucleus of a squamous epithelium cell and an appendage from a flagelated organism or a ciliated cell.

Case Histories

1. A small child, two and a half years of age, was attacked, and from the information gathered, the offense supposedly took place in a certain out-building near her home. A suspect was arrested but, because of her age, the victim was of no value as a witness. The clothes of the suspect were thoroughly cleaned with a tank type vacuum cleaner and the debris was examined microscopically. This debris was compared with the sweepings from the floor at the alleged scene of the attack. Eighteen different types of particles were found to be common to both. They consisted of such things as weed seeds, pieces of dried grass, various types of feathers, parts of dead insects, pieces of fecal matter, et cetera. Through this evidence, a conviction was obtained.
2. A woman past sixty years of age was kidnaped from the street

in Long Beach, California. The suspect threatened her with a knife, forcing her to lie down in a car while he drove her to an isolated spot some miles distance, where he allegedly dragged her from the automobile and had a number of acts of sexual intercourse with her. The woman had a few bruises on her body but was not seriously injured. She took the officers to the spot where she claimed the attack took place. Weed seeds taken from the ground at this location were identical with those found on the seat of the defendant's car, on the victim's coat, and those combed out of her hair. This seed comparison corroborated the woman's story.

XIII

NARCOTICS

WEBSTER DEFINES a narcotic as a substance that induces narcosis (mental lethargy), but most state laws include in their classification of narcotics substances that do not fall into this category, some of which are definitely not sleep-producing or soothing but are excitants, and have just the opposite effect. Again, various drugs of this type react differently with different individuals. For instance, one user of marihuana may be placid, even-tempered, and at times may give the appearance of being in a drunken stupor, while others may act in a truculent and vicious manner.

All narcotics should be analyzed by a chemist for presentation in court, for as part of the *corpus delecti* it is definitely necessary to prove that the substance is a narcotic and is one of those forbidden by the statutes. Only through chemical or microscopic analysis can this be shown.

MARIHUANA

The botanical name of marihuana is *Cannabis sativa, L.* It is an ornamental type plant which may grow to a height of three to sixteen feet. The nodes are from four to twenty inches apart. The leaves are opposite except at the top. The plant is dioecious—the male and female are two separate plants. The staminate, or male plant, is sometimes called flowering hemp. (These flowers are purple). In the pistillate, or female plant, the flowers are less pronounced. The pistillate plant produces the seeds. Originally, hemp was brought to this country for use in the manufacture of rope. The long sclerenchyma fibers in the stocks were excellent for this purpose. As a result of its prolific reproduction it may now be found growing wild in various parts of the country, especially in the Middle West.

The leaves are compound (composed of a number of leaflets) and are generally uneven in number, ranging from five to

thirteen, nine being the most common. The leaflets are dark on top and lighter underneath. On the surface of the leaflets are small globular protruberances which have the appearance under the microscope of little mounds. Also growing out of the surface of the leaflet are one and two celled pubescent hairs. These hairs are semitransparent, and are often accompanied by small particles of brown resinous material. The leaflets are lancelate

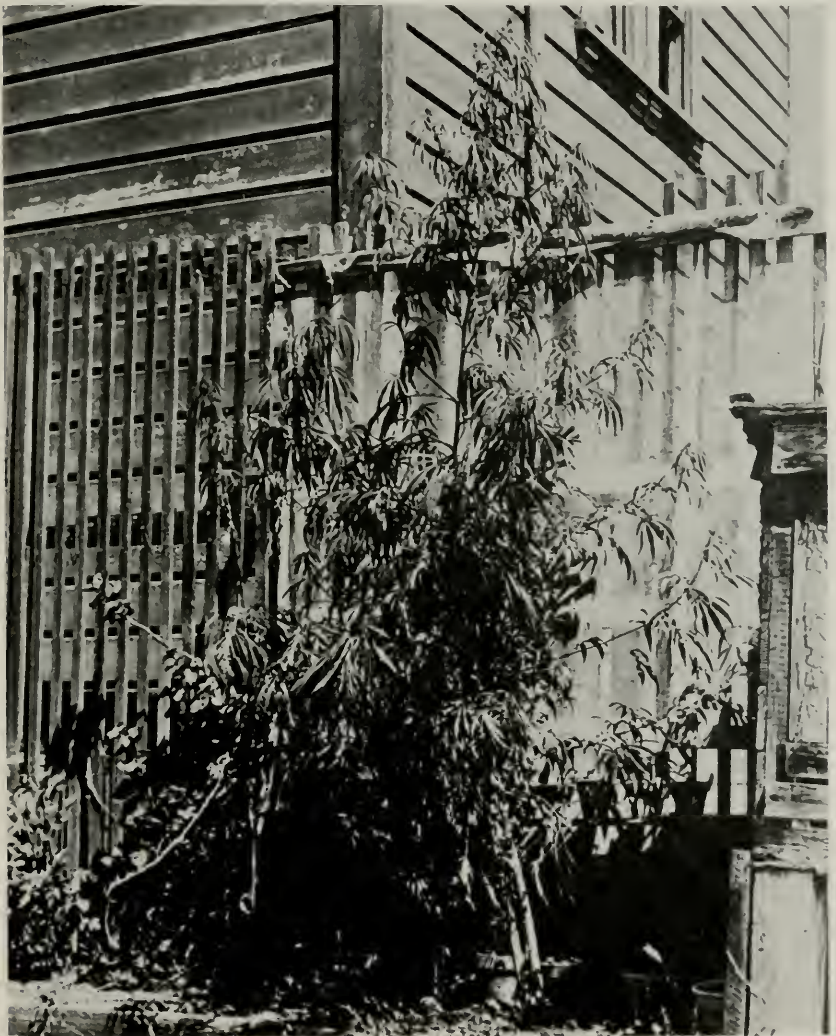


Figure 69. Marihuana plant approximately ten feet in height.

Figure 70. The flowering top of the pistillate or female marihuana plant.

in shape, (pointed at both ends), and have serrated, or saw-like edges. In the small globular protruberances mentioned above are what is known as stone cells, which contain calcium carbonate crystals. When fragments of the leaflets are treated with dilute hydrochloride acid, minute bubbles of carbon dioxide gas are given off. This is not specific for marihuana, as there are other substances, such as catnip, which will give the same reaction.

Figure 71. Marihuana seeds.

Smoking Marihuana

The flowering tops and leaves of the marihuana plant are used for smoking. The process of separating the leaves from the stems and seeds is known as manicuring. The flowering tops and leaves are then dried, are reduced to a powder, and are rolled into handmade cigarettes. Brown paper is generally used, and the ends are tucked in. The cigarette butt is called "a roach." The smoke from the cigarette is inhaled deep into the lungs, and the smoker often cups his hands in front of his face, sucking in the exhaled carbon dioxide gas, thus enhancing the potency of the cigarette.

Figure 72. Marihuana leaf consisting of seven leaflets.

Tests for Marihuana

I. Beams Test – is not specific and of little value, therefore is not given.

II. Duquenois Test – this test is specific for marihuana and should be used when there is any question as to the identity of the substance.

Figure 73. Fragment of marihuana leaf showing pubescent hairs.

A. Reagent
   1. vanillin – 0.4 grams
   2. acetaldehyde – 0.06 grams
   3. ethyl alcohol 95% 20 ml.
B. Extract cannabis with petroleum ether – filter – evaporate (this step is not absolutely necessary, as a good color

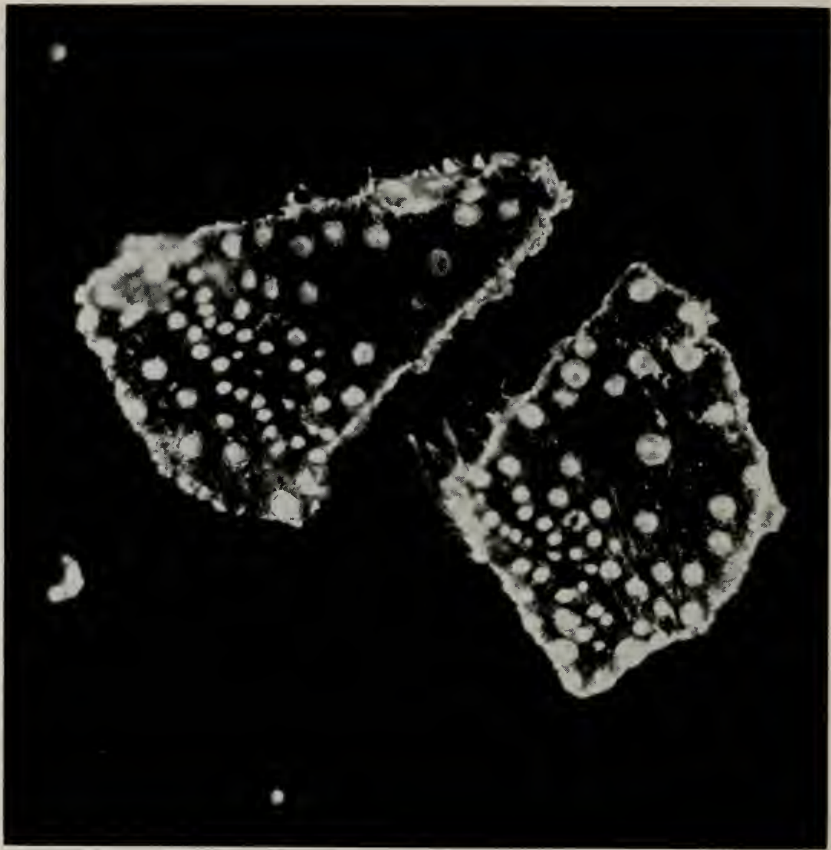


Figure 74. Fragment of marihuana leaf showing globule protuberances.

reaction may be obtained without it).

C. To residue add 2 ml. reagent — 1 ml. con. hydrochloric acid.

D. Resulting color — violet

E. Department of Agriculture tested 250 plants having similar appearance to marihuana and none gave a positive reaction to this test except marihuana.

Slang Names For Marihuana

Foreign Slang

Hashish
Indian Hemp
Bhang
Jamba
Charas

American Slang

Muggles	Love weed
Reefer	Joy smoke
Griffo	Giggle smoke
Greefa	Bambalacha
Mooter	Mu
Mary Weaver	Moocah
Mary Warner	Weed
Mary Jane	Grass
Indian Hay	Tea
Loco Weed	Stick

Experts differ in opinion as to whether marihuana is or is not a habit-forming drug. It probably is no more habit-forming than alcohol; at least there are no withdrawal symptoms.

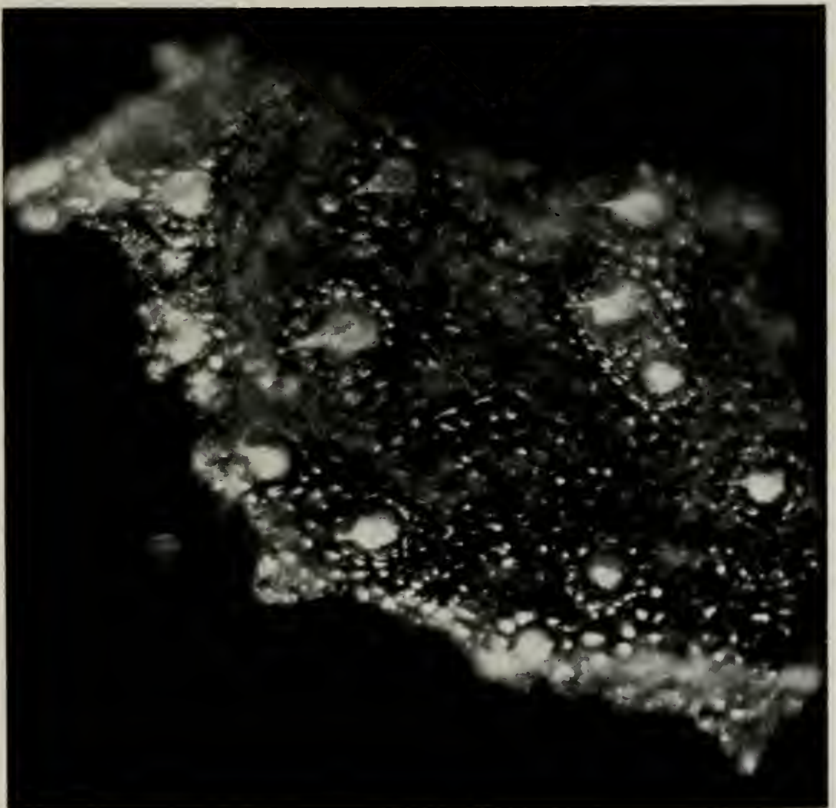


Figure 75. Fragment of marihuana leaf showing globule protuberances and pubescent hairs.

Marihuana dilates the pupils of the eyes and they do not react to change of light. Individuals under the influence of the drug may have almost super-human strength and are indifferent to pain.

Clothing of the Defendent

Clothing of the defendent should be removed as soon as it is possible to do so after the arrest, the debris from each pocket removed, placed in bindles of clean paper, packaged separately and marked. Each package should be sealed with red sealing wax, with the thumb print of the officer impressed in the seal. The debris may be examined later in the laboratory and if marihuana is present it can be identified. Even though cigarettes are found in the possession of the defendent, if minute particles of marihuana are found in the debris from the clothing the case will be strengthened. Many times the cigarettes are not actually found on the person of the suspect, but in the glove compartment of his car, in his room, or among his belongings.

Figure 76. Manicured marihuana. Stems and seeds removed, now ready for smoking.

Marking For Identification

Each cigarette, regardless of the number taken, should be marked with the initials of the officer who found it, and if the cigarettes come from various places, such as a dresser drawer, glove compartment, right pocket of coat, and so on, identifying numbers should be placed on each and the information entered in the officer's notes. Packages of loose marihuana should be placed in envelopes, a separate envelope corresponding to each source of location, and marked with the initials of the officer. All envelopes should be sealed with sealing wax and the imprint of the thumb of the officer placed in the wax.

The reason for such meticulous handling of marihuana or debris, in fact, any kind of narcotics, is to assure its admittance as evidence and to protect the officer in cross examination by the defense. If the evidence has been carelessly packaged, the defense will argue that the debris from the clothing supposedly containing marihuana has been contaminated through coming in contact with the actual material itself. Sometimes three or more individuals are arrested in one room and a cache of narcotics is found. One of them may try to take the blame and may confess to ownership, but if marihuana is found in the debris from the clothing of each of the others, the chance for convicting all of them is greatly increased.

Opium Poppy

The botanical name of the opium poppy is *Papaver somniferum, L.* The most common variety is the white poppy, which is grown in various parts of the world, and especially in the Orient and in Egypt. It has a large seed capsule and at the time of harvesting natives go through the field after sunset, making incisions in the outside portion of this seed pod.

During the night a white, milky exudation collects on the outside. The next morning, before sunup, the men again go through the field and collect this milky substance on poppy leaves. This is then taken to a central operating plant for curing and refining.

The time for harvesting is essential and a rigid schedule must be followed. If the harvesting is delayed, the pods will ripen and the chances of obtaining the better grade of opium is nil. The

incisions are made a few days after the petals have fallen and must be made sufficiently deep to obtain all the juice, but not deep enough to pierce the capsular diaphram, which would allow the milky fluid to escape into the center of the capsule.

At the time the juice is first obtained, it is a white, gummy substance, and contains about 9.5% anhydrous morphine in its moist state. At the central treating plant the collected chunks of opium are allowed to dry for a few days. They are then placed in a vat, water is added, and the whole gummy mass is boiled for many hours. The leaves and other materials are removed by skimming or straining. This adding of water and evaporation process is carried on until the substance becomes a dark brown, almost black, sticky mass of material, which has the characteristic odor of opium. The method of harvesting described here is only one of a number of methods used in various parts of the world. In some parts of Mexico the entire plant is harvested and run

Figure 77. Opium Poppy (Papaver Somniferum).

Figure 78. Opium poppy field.

through presses to obtain the opium juice. Opium obtained in this way is of an inferior grade.

Opium on Illegal Market

Opium is often adulterated with such substances as glycerine or molasses before being sold to the narcotic market. It is wholesaled in containers about the size of a Prince Albert tobacco can. These cans are generally homemade, either of brass or tin plate, and contain about five *tael,* or between six and a half and seven ounces of gum opium. It is also sold in smaller containers in quantities of twenty-five or fifty *fun* jars, or about one-third and two-third ounce respectively. The addict buys it in still smaller quantities, generally in the form of a bindle, which is made by a characteristic folding of a piece of cellophane paper, and containing about one *fun* of opium.

1 *tael* = 590.75 grains = 38.74 grams
1 *fun* = 5.70 grains = .375 grams

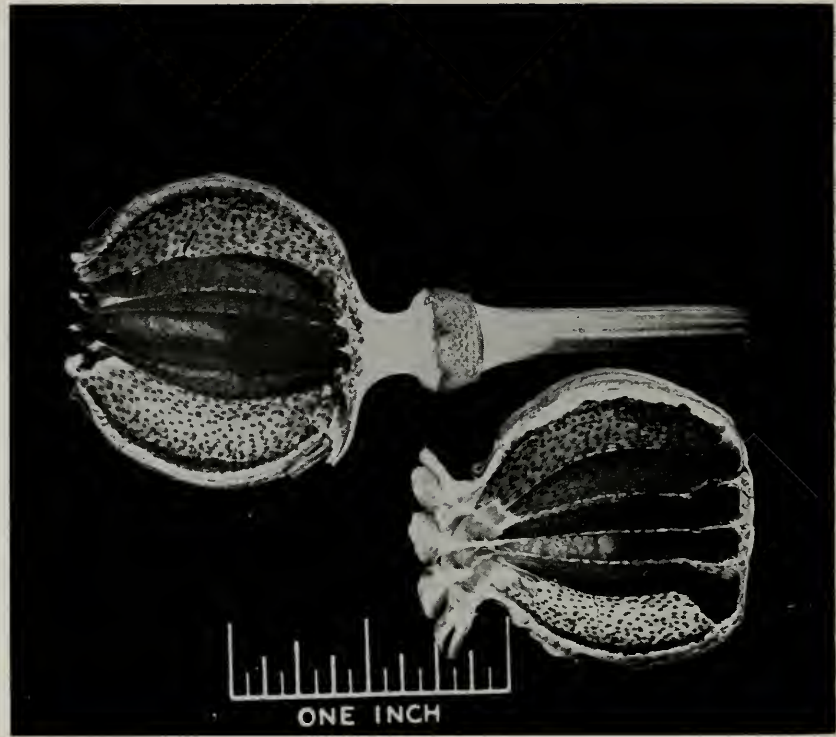


Figure 79. Opium poppy seed pod.

437½ grains = 28.35 grams = 1 oz. avoirdupois
15.43 grains = 1 gram
2.2 lbs. = 1 kilo
1 spoon = 2 grams

OPIUM SMOKING

Opium smoking is performed by the smoker while lying on his side. He uses a thin, metal, rodlike instrument which he heats over the flame of a peanut oil lamp, then, dipping it into the opium, he brings up a drop over the flame of the lamp, and cooks it. This drop is manipulated into the opening of the pipe until it is left adhering to the bowl directly over the orifice. The bowl is then held over the lamp until the opium bubbles and cooks. Three or four long inhalations are taken into the lungs and exhaled through the nose and mouth. In this way a small amount of morphine is absorbed by the smoker. If taken moderately it

may act as a stimulant, enabling the user to ward off fatigue, and to exist for a considerable time with little food. When opium is used in excess, it may cause a person to become an inveterate user, and he may drop to the lowest form of depravity.

Opium Pipes

There are many varieties of opium pipes; some of the elaborately made may have ivory stems and jade bowls, and may cost as much as $1500. Others, of a cheaper design, are fashioned from bamboo, and use a bowl over which is stretched an orange skin, giving a rough, mottled appearance to the outside. Here in America the addict, often being unable to obtain pipes of the finer grade, builds a makeshift outfit consisting of a four ounce dispensary bottle to which is fastened a glass rod at the bottle opening. Near the base of the bottle, on its edge, a small round hole is made through various ingenious methods. One method is to pound continuously in the same spot with the end of a phonograph needle until a hole about the size of a match is obtained. The lamps, unlike those of elaborate design sometimes used by the Chinese, also are usually of a makeshift variety, and are often simply a wick placed in a small hole in the cap of a mentholatum bottle.

Opium — Hypodermically

Some addicts may use opium hypodermically, although this is not a common practice. A person who uses it in this manner generally will be found to have numerous abcesses or scabs where the material has been injected.

Yen Shee

Yen Shee is the partially burned opium residue which remains in the pipe at the time of smoking. It is a black carbon-like material, and contains a high percentage of morphine. The first run Yen Shee is scraped from the bowl, mixed with fresh opium and resmoked. After this smoking the residue is referred to as second run Yen Shee. If opium is hard to obtain this second run product may again be mixed with opium and resmoked. The third run Yen Shee is removed from the pipe and is mixed with water or wine, making a solution which is known as Yen Shee

Suey. Yen Shee Suey is drunk by the addict to tide him over until a fresh supply of opium can be obtained.

Tests for Opium

One of the best tests for opium is burning a small piece in an open flame and smelling the smoke. It has a typical sweetish odor, given off by no other substance. When a quantitative analysis is necessary, it is accomplished by identifying quantitatively the amount of morphine contained in the opium. (For such an assay, see *Detection of Poisons,* by Autenreith & Warren).

If a little opium is dissolved in distilled water it will give a positive alkaloidal reaction with Meyers & Wagners Reagents.

The Opium Alkaloids

It is difficult to give a precise definition of the word "alkaloid." It is a nitrogenous salt-forming base, generally of a highly poison-

Figure 80. Opium smoking paraphernalia.

ous nature. Over 800 alkaloids are known, although only about twenty-four are in common use. Gum opium contains some twenty-four known alkaloids, of which morphine, papaverine, apomorphine, and codeine are probably the most important. The amount of morphine contained in opium is dependent upon two factors, (1) the locality from which it is derived (India, China, Mexico, et cetera), and (2) the amount of adulteration to which it has been subjected. The author has quantitatively analyzed opium from various sources and has found some to contain as little as five per cent morphine, while in another instance a supply of oriental opium yielded eighteen per cent by weight.

Morphine

The accepted formula for morphine is $C_{17}H_{19}O_3N$. A salt of the alkaloid is normally dispensed on the legal market in four forms, tablets, cubes, powder, and solution. It is a whitish powder, light in weight, and bitter to the taste. In tablet form it is generally mixed with milk sugar (lactose), which acts as a binding agent. The tablets are small, about the size of a saccharin tablet, and may contain one-eighth, one-fourth, or one-half grain of morphine. A cube of morphine is about three eighths of an inch per side. It feels very soft and chalky to the touch, and has the appearance and weight of a piece of magnesium carbonate. Powdered morphine is white, and feels light and fluffy. Morphine is also put up in ampules, each ampule containing enough morphine sulphate in distilled water for one injection. Ampules also may contain one-eighth, one-fourth, or one-half grain.

Morphine is generally administered hypodermically as morphine sulphate, either by a medical doctor or, when used illegally, by the addict. Because of its insolubility in water, the pure alkaloid is never used, but rather is used in the form of a salt, such as morphine hydrochloride or morphine sulphate. The alkaloid is not soluble in water but is readily soluble in an ammoniacal solution. The salts are soluble in water with a pH on the acid side.

Much of the morphine used by the illegal trade is obtained through burglarizing medical offices or pharmacies, so it is often found on the addict in tablet or powder form.

Packing and Marking

Because of its softness, great care should be taken in packaging morphine tablets. They may be crushed easily, and for that reason, unless the container used is carefully chosen, the physical appearance may be altered to such an extent that they will not be admitted as evidence. If the officer states that he removed four

Figure 81. (Micro Crystalline Test) Dilaudid-hydrochloride with K-nitroprusside.

tablets from the defendant, and if later, when this evidence is presented in court, the tablets have inadvertently been crushed and are more or less in powdered form, the chances are the case will be dismissed. If possible, material of this type should be placed in a glass container and the cork sealed; the container then should be placed in an envelope, sealed, the thumb print of the officer put on the seal. Both the container and envelope should be marked with the initials of the officer and with other identifying characteristics to show place of origin, and so on.

Tests for Morphine

1. *Mecke's Test* (a one-shot test for opium alkaloids)

Reagent:

0.5 grams of selenous acid in 100 cc. of concentrated sulphuric acid.

Test Procedure:

A very small amount of the suspected substance is placed in the depression of a spot plate and four or five drops of the reagent added.

Color Reactions:

Heroin: Yellow-green changing rapidly to bright green.

Morphine: bright blue changing to blue-green then to dark green

Dilaudid: Yellow to olive green.

Dicodid: Light greenish blue.

Eucodal: Yellow changing slowly to orange with green edges and finally changing to a reddish brown.

Codeine: Blue-green.

Pantopon: Dark green changing to black.

2. *Micro Crystalline Test*

The best microcrystalline test for morphine is with Marme's reagent.

Marme's Reagent

Cadmium iodide — 30 gms.
Potassium Iodide — 60 gms.
Distilled water — 180 cc.

In solutions containing 1 part of morphine in 50 parts water, a gelatinous precipitate is formed which changes quickly to crystals. It has a silvery appearance and the crystals are very characteristic. If a small amount of the precipitate is placed

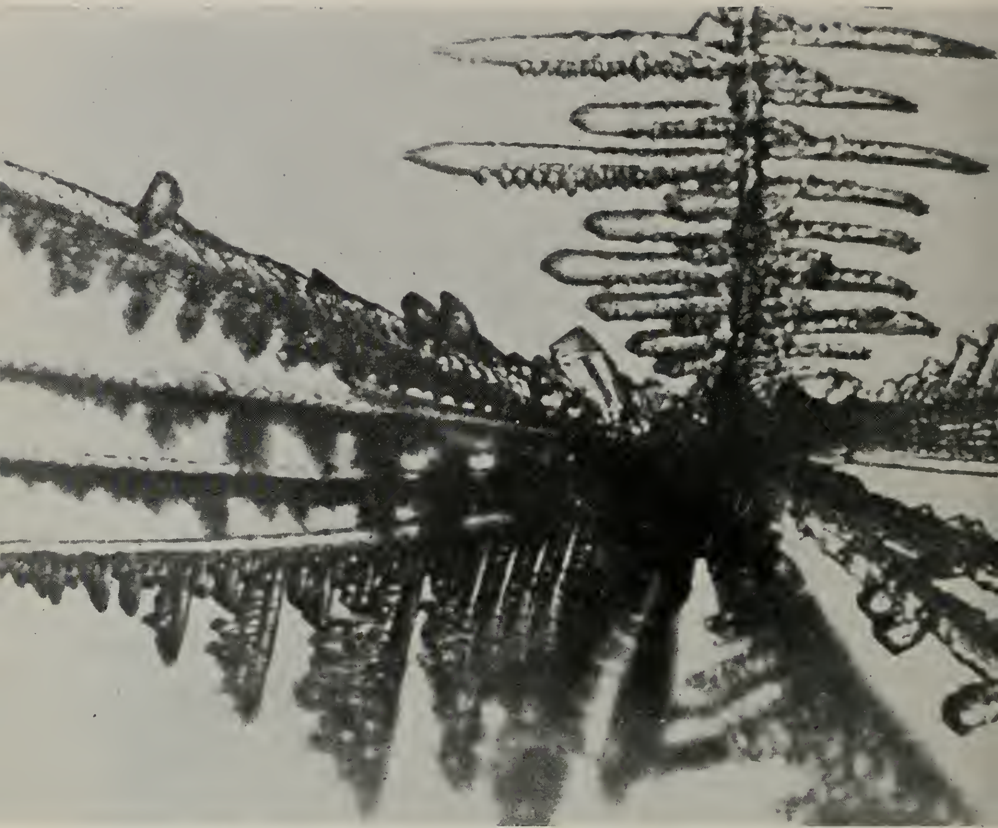


Figure 82. (Micro Crystalline Test) Amidon hydrochloride with palladium chloride.

on a microscope slide and covered with a cover slip, the crystals may be identified microscopically at about 300 dia.

Use by Addicts

Morphine is seldom used orally by the addict, as this method requires more of the material to give the same effect as intraveneous injection. If the addict can obtain a hypodermic outfit he will proceed as follows: he will dissolve from one-half to two grains morphine, depending upon his tolerance, in a small amount of distilled water; this solution he will place in a common tablespoon, the handle of which has been bent into a crook; the solution he then will heat over a flame until it is warm; he

will then draw the material into the hypodermic syringe through a pledget of cotton, which acts as a filter; he will then turn the hypodermic syringe with the needle upward, and compress the syringe until the solution just begins to leave the needle—this latter process drives out any air bubbles that may be present, for if air bubbles enter his vein they will cause a prickly feeling, and if bubbles of sufficient size were to be injected, they might

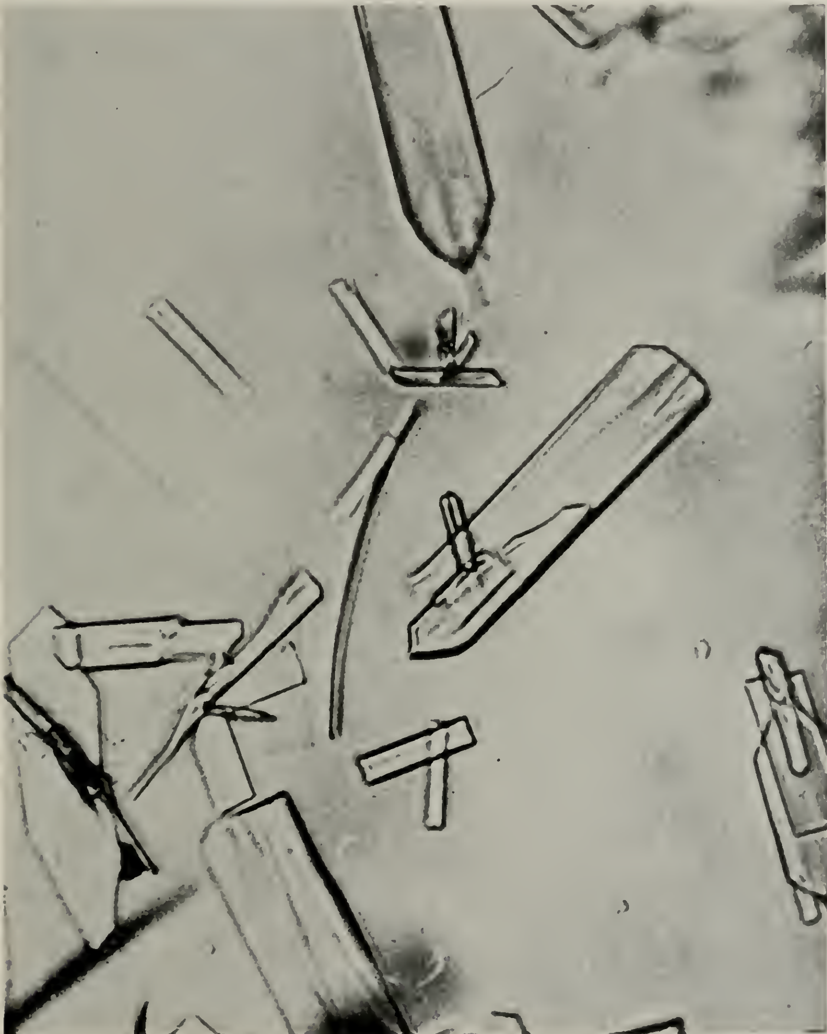


Figure 83. (Micro Crystalline Test) Demerol with platinum chloride; scratched slide.

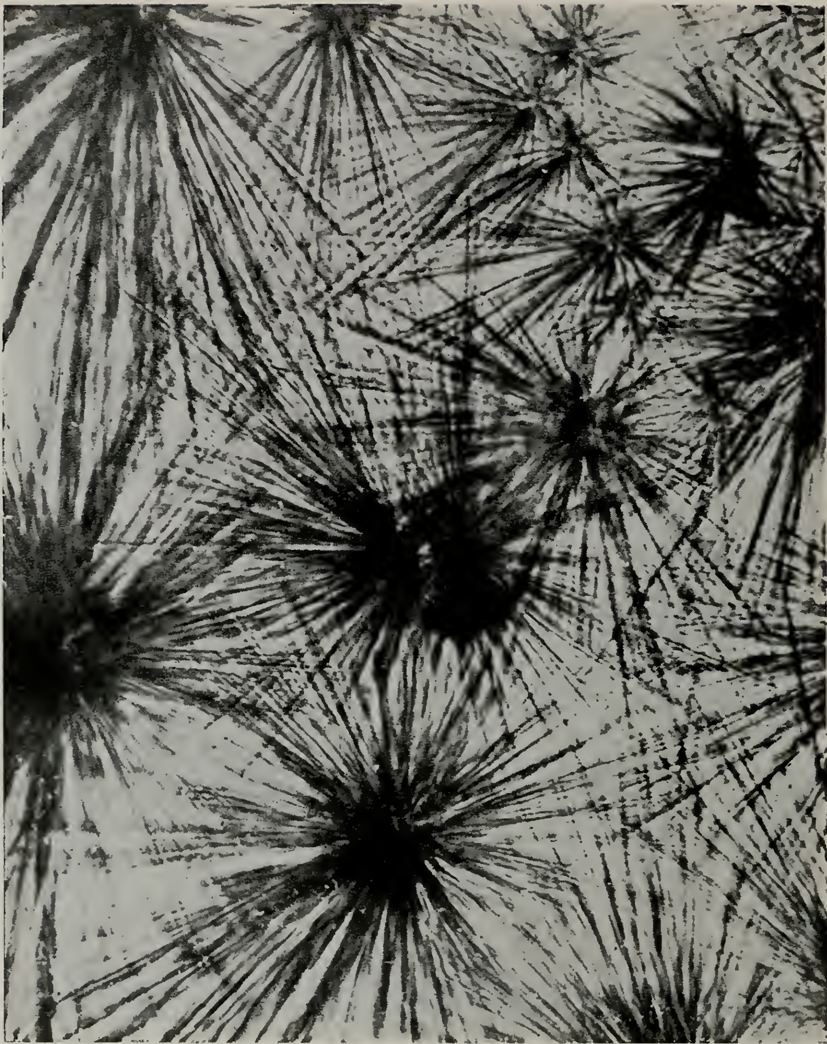


Figure 84. (Micro Crystalline Test) Mescaline sulfate extract from Peyote with platinum chloride.

cause death—he then will insert the needle into his main vein on the inside of his arm at the elbow, and slowly he will force the contents into his blood stream.

Often the addict, being unable to get a standard hypodermic outfit, uses a makeshift apparatus consisting of an eyedropper to inject the solution and a safety pin or corsage pin to open up

a hole in the vein. The author has even seen small pen knives used in this way. Because of this unsanitary procedure, infection may result, and when healed, will leave characteristic scars.

Effect on the Individual

Morphine acts as a sedative and is habit forming in that, as with all of the opiates, definite withdrawal symptoms appear.

Figure 85. (Micro Crystalline Test) Heroin hydrochloride with mercurous iodide.

Figure 86. (Micro Crystalline Test) Cocaine hydrochloride with gold chloride.

The longer the addict has been using the drug, and the greater his tolerance, the more violent these symptoms will be. If he is taken off the drug immediately and his tolerance has been exceedingly great, the effect may be fatal; at least it will result in nausea, vomiting, abdominal pains, cramps in the legs, et cetera, which may last for many days—sometimes as much as a week—

and is accompanied by a characteristic pasty appearance of the face. This type of withdrawal is referred to by addicts as "taking it cold turkey." A user is seldom permanently cured of addiction. He may remain off the stuff for some time, but sooner or later he will generally fall back into the old habit.

Addict Under Influence of Morphine

An addict under the influence of morphine will show the characteristic appearance of the eyes. The pupils are contracted to pin points and do not react to strong light. He may sometimes talk incoherently, and may appear to be in a stupor.

HEROIN (DIACETYL MORPHINE) C_{17} H_{17} O N $(O.CO.CH_3)2$

Although at one time heroin was legally used as a substitute for morphine, it is now prohibited in the United States, and any of the substance found on the narcotic market is either illegally manufactured or is smuggled in from other countries, Mexico being the most common source.

Heroin may be prepared by heating powdered anhydrous morphine with aceytal chloride, using a water bath. It melts at 176° to 178° F. It is insoluble in water, but is soluble in hot alcohol, chloroform, or benzine.

How Used

Heroin is generally used as a narcotic in the form of the hydrochloride. It is considered very potent, and some authorities estimate it to be nearly sixteen times as strong as morphine. For that reason it is highly prized on the drug market. It may be cut (adulterated) a number of times by the peddler, using milk sugar for the purpose. Pure heroin hydrochloride is a whitish powder, but often when found on addicts or in the possession of peddlers, it may have a grayish appearance. This may be due to incorrect procedures in manufacturing or to the type of material used for adulteration. Pure heroin hydrochloride, for the reasons stated above, seldom reaches the addict.

Tests: see Mecke's Test, under "Morphine."

Usage by Addicts

Heroin hydrochloride is used hypodermically, in the same manner as is morphine. Prior to World War II the Japanese

manufactured a pink pill which contained heroin and which was sometimes smoked by addicts. None have been seen on the narcotic market for a number of years.

Effect on the Individual

The effect on the addict is similar to that of morphine. It is just as habit forming, and because of its adulteration, the addict's tolerance is about the same. The addict under the influence has the characteristically contracted pupils of the eyes, as with other opiates, and will suffer the same type of withdrawal symptoms if he is forced to discontinue the habit.

CODEINE

Codeine

Codeine is Methyl Morphine (C_{18} H_{21} NO_3 H_2 O). It occurs in opium to the extent of from .2% to .8%. Codeine differs from morphine and most of the other alkaloids in that it has a much higher solubility in water. It is almost insoluble in sodium or potassium hydroxide solutions; here again it differs from morphine, which dissolves readily in these alkalies. It may be prepared by heating morphine to about 60° in a methyl alcohol solution containing methyl iodide and sodium or potassium hydroxide.

Tests for Codeine: see Mecke's Test under "Morphine."

Use

Codeine is seldom used by the addict as a narcotic and is not considered by them as habit forming. It is not as effective as a sedative or for alleviating pain as morphine, and has only about 1/20 of the toxicity. It is often given orally to induce sleep, or is dispensed in cough syrups. It is found on the market in tablet form, and may have a faint, brownish tinge. The oral tablets which generally contain about one-half grain, are rather hard to the touch, and are considerably larger than a one-fourth or one-half grain morphine tablet.

PANTOPON

Pantopon is a mixture of the hydrochlorides of the opium alkaloids, generally containing about 50% anhydrous morphine

hydrochloride. They are put up in rather large brown tablets, hard to the touch, and range from one-twelth to one-half grain in size.

Tests

If burned it has a slight odor of burning opium. Morphine may be extracted and identified. See also, Mecke's test under "Morphine."

Use

Pantopon is used as a sedative, and may sometimes be used by the addict in emergencies to alleviate his craving, although it is not his preference.

LAUDANUM

Laudanum is a tincture of opium in alcohol, and contains about ten grams of powdered opium per one hundred cc. It is a black liquid and may occasionally be found on the narcotic market. It is sometimes prescribed by medical doctors for ear-ache, and for other less serious ailments.

Tests

Morphine may be separated from the solution by the Stas-Otto method for separation of alkaloids.* When evaporated to dryness and the residue burned, it will give the odor of burning opium.

PAREGORIC

Paregoric is a tincture of opium containing about 1.84 grams of powdered opium per ounce. It is a dark liquid, and has the identifying characteristic odor of oil of anise (licorice).

Tests

Separate and identify the morphine contained in the solution by Stas-Otto method.*

Use

Paregoric is prescribed medicinally, but is little used on the narcotic market. It is sometimes used by an addict to tide him over until he can get morphine or heroin.

---

*See *Detection of Poisons*, Autenreith and Warren.

DILAUDID, DICODID, EUCODAL

Dilaudid (Dihydro-morphinone), Dicodid (Dihydro-Codeinone), and Eucodal (Dihydro-hydroxycodeinone) have been prepared from morphine, codeine, or thebaine by oxidation and reduction methods. Their properties are similar to morphine and its other derivatives. They are often prescribed as hydrochlorides, phosphates, and bitartrates. Dilaudid seems to be more commonly used by the medical profession than are the other two, and is usually in the form of small white tablets, very similar in appearance and size to a one-half grain saccharin tablet, and harder to the touch than a morphine tablet. These are habit forming, and characteristic withdrawal symptoms are noted if their use is discontinued.

Tests: see Mecke's test, under "Morphine."

DEMEROL HYDROCHLORIDE

Demerol is a relatively new synthetic drug which gives a physiological reaction very similar to that of morphine; it has been found to be definitely habit forming in that the addicts will use it when other opiates are not available. It is a white crystalline powder, slightly bitter to the taste. It is soluble in water, thus making it easy to use hypodermically. It may also be administered orally. It comes in the form of ampules, elixer, and tablets.

Tests

One of the best methods of determining demeral is a microcrystalline test, using picric acid as a reagent. When the microscope slide is scratched, demeral-picric acid crystals form; these look very much like stars.

DOLOPHINE (AMIDON) (METHEDON)

Dolophine was formerly known as IG Compound 10820 (amidon hydrochloride). It is a white crystalline substance, bitter to the taste, and soluble in water or in alcohol. It is a morphine-like analgesic, possessing many of the pharmacologic properties of morphine, although not with the same amount of narcosis or mental confusion. It may be administered orally, intravenously,

or subcutaneously. It is habit forming, and, if continually used, addiction may result.

COCAINE (C_{17} H_{21} O_4 N)

Cocaine is an alkaloid derived from the leaves of the coca plant (Erythroxylon coca), indigenous to Peru and Bolivia. At the present time this plant is cultivated in several countries, Java producing the largest quantity. If taken in moderate doses the mental and bodily powers are increased, fatigue is abolished, and exhausting feats can sometimes be carried out. Some of the natives of Peru chew the leaves to give them the ability to go without food for long periods of time with little or no discomfort. It is used therapeutically, generally in the form of cocaine hydrochloride, as a local anesthetic. Sometimes it is used in the extraction of teeth, although, for this purpose, novocain is preferable. Cocaine dilates the pupils of the eyes, but the user still shows a reflex to light; in this respect it differs from atropine.

Uses by Addict

The habitual user of cocaine may acquire a tolerance for exceptionally large doses, and after continual use it may cause degeneration to the central nervous system; this may eventually result in insanity. Cocaine hydrochloride may be taken hypodermically or may be sniffed into the nostrils; the latter method of use gives rise to the name "snow-bird" for a cocaine user. When taken into the nostrils it has a degenerative effect upon the mucous membrane and often results in the formation of ulcers. The addict who uses cocaine in this way develops a nervous habit of brushing his nose with his hand at frequent intervals. Cocaine gives the user a sense of well-being and increases his ego. It fortifies his temerity in committing holdups, and while under the influence, he may kill with little provocation. It has sometimes been used in the form of coke highballs—an alcoholic drink to which a small amount of the drug has been added.

Physical Appearance and Tests

Cocaine hydrochloride is generally found on the addict in one of three forms, either a fine white crystal (snow) resembling epsom salts, larger crystals similar to rock candy, or as a liquid. A crystal of cocaine touched to the tip of the tongue for a short

period of time will have a numbing effect. This method may be used as a quick qualitative test.

For positive identification the best test is through identifying the crystals formed in a precipitate when a 10% solution of gold chloride is added to the solution of cocaine hydrochloride. This test is very sensitive, as a few crystals may be formed in a dilution of 1 part cocaine hydrochloride in 20,000 parts of water. One type of crystal forms if the solution is very dilute, while an entirely different crystal results in more concentrated solution.

Narcotic Slang

Mojo	Morphine
Junk	Morphine
Stuff	Morphine
Mary	Morphine
M	Morphine
White (stuff)	Morphine
Pen Yen	Opium
Black (stuff)	Opium
Mud	Opium
Tar	Opium
O	Opium
H	Heroin
Coke	Cocaine
Coconuts	Cocaine
Snow	Cocaine
C	Cocaine
Cecil	Cocaine
Charley	Cocaine
Pop	Injection
Fixup	Injection
Shot	Injection
Ping and Wing	Injection
Jolt	Injection
Joint	Hypodermic device or opium pipe
Business	Hypodermic device or opium pipe
Layout	Hypodermic device or opium pipe
Spike	Hypodermic needle
Gong	Opium pipe
Joint	Opium pipe
Layout	Opium pipe or marihuana cigarettes
Yen Pock	Small cooked opium pill
Yen Shee Gow	Crooked instrument for scraping Yen Shee

Yen Hock	Instrument to hold pill for cooking
Jim How	Headrest used in smoking opium
Gee Rag	Strainer at base of bowl in opium pipe
Yen Shee	Partially burned opium
Yen Shee Suey	A Yen Shee solution
Piece	1 oz.
Kite	1 oz.
Bindle	Package of narcotic, usually small, folded in a special way
Kick the Gong	Smoke Opium
Spread	Smoke Opium
Lay on Hip	Smoke Opium
Yen On	Withdrawal of narcotics
Kicking the Habit	Withdrawal of narcotics
Sick	Withdrawal of narcotics
Cold Turkey	Quick withdrawl of narcotics
Looking	Trying to buy narcotics
Buzzing	Trying to buy narcotics
Scoring	Buying narcotics
Connecting	Buying narcotics
User	Addict
Hype	Addict
Hygelo	Addict
Hoppy	Addict
Junker	Addict
A Bird's Eye	Small amount of narcotics
Geeser	Small amount of narcotics

HYPNOTICS

Webster defines a hypnotic as any agent that produces or tends to produce sleep; an opiate; soporific; a narcotic. Although this definition includes narcotics and opiates, these generally fall into a different classification in most state narcotic laws from those designated as hypnotics.

Hypnotics, as defined by the various state laws, include barbituric acid and its derivatives, chloral hydrate, the sulphones, paraldehyde, et cetera, and are primarily administered as sedatives. When in tablet form they are larger than narcotic tablets and harder to the touch. Theoretically they are not classed as habit forming, in that they do not produce definite withdrawal symptoms as do the opiates, but there is little doubt that when their use is continued over a long period of time the tolerance increases

and they have a definite reaction on the nervous system; the user feels that he cannot sleep without resorting to their use.

Barbiturates (Barbituric Acid Derivatives)

Di-ethyl barbituric acid (veronal) is a urea derivative and is the basic origin of more than one hundred similar products under various trade names. As these barbiturates are the most commonly used of all hypnotics, the trade names of a few of the most common barbituric acid derivatives are listed below, with a brief description of each.

Allonal Roche	1 grain, 3/8" tablet, white
Alurate	1 grain, 3/8" tablet, white
Amytal (Sodium)	1½ grains, 5/16" tablet, white
Amytal (Sodium)	3 grains, 5/8" capsule, blue
Barbital	5 grains, 3/8" tablet, white
Butisol (Sodium)	1½ grains, 9/16" long capsule, light lavender
Cyclopal	2¼ grains 3/8" tablet, white
Cyclopal	¾ grains 3/8" long, capsule, dark brown
Dial	1½ grains 7/16" tablet, white
Di-Seds	2 grains, ½" long capsule, ½ pink, ½ brown
Ephredine & Amytal	¾ grains, amytal, yellow capsule, 5/8" long
Ipral (Sodium)	4 grains, oval, 5/8" x 5/16" tablet, white
Ipral (Calcium)	2 grains, 5/16" tablet, white
Luminal (Sodium)	1¼ grains, 5/8" tablet, white
Nembutal (Yellow Jackets)	1½ grains, 9/16" long, capsule, yellow
Neonal	1½ grains, 3/8" tablet, white
Pentobarbital (Sodium)	1½ grains, 9/16" capsule, light brown
Seconal (Sodium)	1½ grains, 9/16" capsule, orange-red
Seconal (Sodium)	¾ grains, 7/16" capsule, orange-red

The descriptions given above do not include all the various sizes of tablets and capsules which may be sold under these names.

Below is a list of the less common trade names; in each case only the name is given, and not the various ways in which it may be dispensed.

1. Adalin
2. Alphenol Caps.
3. Axotal — tablets
4. Amino-Neonal — tablets
5. Barbacet — tablets
6. Barbabrome
7. Bromidia
8. Bromionyl & Barbital
9. Bromiphen — elixer
10. Bromural
11. Carbal — tablets
12. Carbital Kapseals, elixer
13. Carbromal
14. Cibalgine — elixer, ampules, tablets
15. Delvinal — elixer, capsules, solution
16. Dialacetin — tablets
17. Diphenylhydrantoin (Sodium) powder, capsules, phenobarbital caps
18. Di-Barbs Tablets
19. Dormaphen — tablets
20. Dormelix — elixer, tablets
21. Duobrophen — elixer
22. Elixsed
23. Eskaphen B & Phenobarb
24. Ethalyl — elixer, capsules, tablets
25. Eudital — tablets
26. Evicyl — tablets
27. Evidorn — capsules, tablets
28. Evipal — ampules, tablets
29. Lumalgin — tablets
30. Lumaspirin — tablets
31. Mebaral — tablets
32. Medinal — elixer, powder, tablets
33. Napental — elixer, capsules
34. Neuronidia
35. Neuronal
36. Nostal — tablets
37. Potalidin — tablets

38. Palapent — elixer
39. Pental Caps
40. Pento-del Caps.
41. Pentothal — ampule
42. Pernoston — tablets, ampules
43. Peralga — powder, tablets
44. Phanodorn — tablets
45. Pheno-Bepadol — elixer, tablets
46. Pheno-Pyrine — tablets
47. Presidon — tablets
48. Pyraminal — elixer, tablets
49. Sandoptal — tablets
50. Sedaphen
51. Sed-Ems Caps
52. Sedobarb Tabs
53. Segmodal — ampules
54. Trional — tablets
55. Tuinal — pulvule
56. Veronal — tablets, powder, elixer

Tests for Barbiturates

For a quick color test for barbituric acid, proceed as follows (use a spot plate) ; to a 1% cobaltous acetate solution in methyl alcohol add a few drops of a 25% ammonium hydroxide in methyl alcohol solution and a small piece of the material to be tested. If the substance contains barbituric acid or is a barbituric acid derivative, a lavender color will result. Some chemists find that adding the reagents to the suspected substance gives a better reaction.

The test is very sensitive, and minute quantities of the substance will give a positive reaction. This test is not specific for barbiturates.

Each of the various barbituric acid derivatives have different difraction patterns, thus when X-ray difraction equipment is available it is the best procedure for identification.

If controls are set up the specific derivative may be identified for court with greater ease than by chemical testing. Some of the court complaints are drawn up stating that the substance is a barbituric acid derivative, while other complaints state that the suspected drug is a barbituric acid derivative, to wit: sodium

pentathal, amytal, et cetera. In the latter case it may be necessary to specifically identify the derivative itself.

CHLORAL HYDRATE (KNOCKOUT DROPS)

Chloral hydrate contains not less than 99.5% CCl_3 $CHO.H_2O$, and is made up of colorless, transparent crystals. It has a slightly acrid odor and is strongly aromatic. The odor is rather pungent to the nostrils. The crystals are volatile if left exposed to the air. Chloral hydrate is readily soluble in water or alcohol, and is therefore used as knockout drops. When administered in this form it is not recognizable by the victim. The average dose is generally about ten grains.

Tests

Place a little of the suspected material in a test tube. Add 2 cc. distilled water, 4 drops of sodium hydroxide, 3 drops of aniline. Warm over a Bunson burner. The disagreeable odor of phenylisocyanide is given off.

SULPHONES (SULPHONAL, TRIONAL, AND TETRONAL)

The sulphones are sometimes administered as sedatives in the form of sulphonal, trional, and tetronal. They have weak analgesic properties, are absorbed slowly, and the hypnotic effect is delayed and prolonged. They are used in simple insomnia. They are white, odorless, almost tasteless crystalline powders: they are slightly soluble in water or alcohol, and are readily soluble in boiling water.

PARALDEHYDE

Paraldehyde is a polymer of acetaldehyde. It is a colorless, transparent liquid, and has a characteristic, not unpleasant odor. It is soluble in water or alcohol. It is used as a sedative, especially in mental hospitals.

Tests

If a small quantity is heated with a little sulphuric acid it is converted into acetaldehyde, which is recognizable by a characteristic odor.

PEYOTE

The peyote cactus is quite common throughout the Western portion of the United States and in Mexico. The small mescal

buttons contain the alkaloid, mescaline, which has been used by the Indians for many years. Mescaline has various effects upon different individuals, and at times may act as a hypnotic or as an excitant.

SEARCHING FOR NARCOTICS

In General

A narcotic officer is probably better versed in the art of searching or shaking down persons, premises, or automobiles

Figure 87. Peyote cactus.

than is any other investigator. His shrewdness is necessitated by the cunningness and the ingenuity of peddlers and addicts and by the insignificant size of the contraband for which he is searching.

Narcotics are often worth more than their weight in gold, and, as there is always a ready market for them, the peddler is constantly devising new ways and means for their transportation and concealment until the sale is consummated.

Although the general procedure in searching for this type of contraband applies somewhat to all other fields of investigation, too much emphasis cannot be placed upon the meticulous care necessary in a search for narcotics. A search, wherever made, should be systematic. The searcher must go over each article, piece by piece, covering all ground as he goes. It is a good procedure for one officer to follow through after his partner has completed his search, covering the same ground again. He may be able to see things that were overlooked in the first search.

Searching A House

When searching a house for narcotics each man should take a room, and he should search that room alone, until he feels that he has thoroughly and completely covered every possible place of concealment. The officers should then trade rooms and again go over them thoroughly.

It might be well to list some of the possible places of concealment.

In the kitchen, all open packages, such as beans, sugar, flour, breakfast foods, dried fruits, coffee, tea, cocoa, should be emptied out and searched. All portions of the refrigerator, including opened milk containers, ice trays, cans of jam and jellies, dishes containing soups, stews, or cans containing bacon grease, et cetera, must be checked. Narcotics are often placed in rubber finger stalls, tightly sealed, and are then hidden in the various liquids mentioned above.

All canned goods should be looked over for fake bottoms and for signs that they have been resoldered. All pots and pans, or any other type of container must be searched; wastepaper baskets must be emptied; vacuum cleaners and carpet sweepers opened. All objects in drawers, all linens, dish towels, and cloth-

ing must be removed. Table legs and chair legs must be checked to see if they can be removed, or are hollow; all dishes must be gone through, for bindles of narcotics may be found between plates in a large stack. The air vents in stoves, the ovens, and any removable stove parts must be searched, also the underneath sides of any article of furniture and appliances in the house. If an old fashioned stove pipe opening is sealed off, it is wise to open and investigate it.

In the bedroom, mattresses should be searched carefully to see if they have been opened and resewed; also, the spaces between the springs and the frame of the beds. Castors must be removed and searched, knobs on old fashioned iron bedsteads unscrewed. All drawers must be searched thoroughly. Rugs and carpeting should be lifted. Open boxes of face powder, lipstick containers, and opaque bottles must be investigated. When going through each separate article of clothing, special attention must be paid to hidden pockets; to openings in the back, underneath the collar of the coat; to indications that any seam or a portion of the clothing has been opened and resewed. When investigating shoes, it should be determined whether any of the heels are removable or loose, or show signs of having a false compartment.

All drawers in any part of the house must be removed, and the bottoms, sides, and back, searched, for bindles of narcotics are often secured to portions of the drawer, underneath stands, dressers, tables, and other pieces of furniture with cellophane tape.

Other places in the house which should be searched are behind light fixtures and switches; on tops of doors (sometimes a groove is made in the top of a door and bindles of material are concealed therein); inside locks on doors; in telephone boxes; inside of fireplaces; in all kinds of musical instruments; radios, dummy fixtures, and the backs of photographs; it may be necessary to take the latter apart or to remove them from their frames.

All books should be thumbed through, for sometimes a compartment is made inside a book by cutting out a square place through many of the pages, allowing a considerable cache to be concealed.

In looking in cupboards, openings to the attic, and out of the way places, condition of the cobwebs and dust must be observed

in order to see if they have been disturbed. The vent pipes in the bathroom and inside of the water closet, the curtains, drapes and metal curtain rods, should be carefully searched. The wooden portion in the hem in the bottom of a blind should be removed, and light bulbs unscrewed and the sockets checked. Other probable places are inside the legs of old fashioned bathtubs; the bottom of davenports; between the male and female plug of extension cords. If a floor lamp will come apart, the inside of the pipe section must be checked. If the fireplace appears to be unused, the ashes must be investigated.

The medicine closet and articles contained therein, baseboards and moldings must be checked. Tears in the wallpaper or bulges underneath wallpaper, and any loose boards or floorings may indicate hiding places. The walls should be noted to see if plaster has sifted down, thus indicating that some piece of wood or trim has been removed. The obvious, such as a cardboard carton or some other such container sitting in plain sight in a room may contain narcotics. There may be hidden panels which are controlled by a concealed lock; some locks have been found which could only be opened by making a contact between two nail heads. Window sills may have removable portions, boards may show marks of wear, as if they had been removed at some time.

Searching The Premises Outside A House

The garage should be gone through systematically, the investigator being guided to some extent by the cobwebs and dust. The tools and tool chests, the inside of handles may hide drugs. Such objects as shovels and trowels may indicate that they have been used to dig holes in the ground. All the grounds must be searched for signs of freshly dug plots. Stepping stones or slabs of cement that show signs of having been recently removed must be investigated. The ash cleanout vent for the fireplace is a likely cache. Fence posts and garden furniture may have hollowed out portions.

Searching A Car

The investigator should look under the seats; inside the seats; in torn places in the upholstery, et cetera. He must get underneath and search along the frame, and the under portion of the

hood. He must search inside and underneath the glove compartment, and in other places on the car where the contraband can be held in place by adhesive tape. He must look for false gas tanks; search inside spare tires; behind hub caps; under the fenders; on top of sun visors.

Searching A Person

The clothing should be gone over systematically. It must be noted if material is sewed in the lapel, the collar, lining of the coat, tops of the trousers or cuffs.

The orifices of the body such as the mouth, nose, rectum and vagina must be searched. If it is a woman prisoner, a policewoman must make a thorough search, including the suspect's hair, rats, and pocketbook, even between the fingers.

A bindle may be concealed in a rubber container and held under the tongue, and in some cases at the time of search the suspect may swallow the contraband. If this happens, a stomach pump should not be used. Rather a doctor should be prevailed upon to administer an emetic, and in that way the substance may be emitted unharmed.

The investigator must be suspicious of all artificial limbs and bandages on the body. Bindles of narcotics may be secured between the legs or on the bottom of the feet with adhesive tape.

When a man and a woman are arrested it is generally difficult to make a complete search at this time, especially in the case of a woman, thus during the process of transporting them to the station special care should be taken to see that the material is not passed from the man to the woman and then disposed of by her. Sometimes officers are careless in this procedure, when the woman may actually be the possessor of most of the narcotics. After the suspects are removed from the police car at the station the inside of the vehicle should be searched, for it is possible that the prisoners may have concealed narcotics there while being transported.

Peddlers On Streets and In Cars

Peddlers use many ingenious methods to distribute their wares to the addict. They have concealed narcotics in baby carriages and on the persons of the small children accompanying

them; inside of canes; flash lights; underneath rings; in the backs of watches; or in the palm of the hand. They have been known to carry a small piece of metal, with the contraband secured to it by rubber bands, thus if an officer approaches they can throw it to such a distance that it becomes almost impossible to recover it.

Peddlers have been known to visit a physician and to secure a prescription for some form of sedative, such as nembutal or seconal. They then remove the barbiturate from the capsules and fill each with some narcotic such as heroin; then, fortified with the prescription in their possession, they may boldly walk down the street to make their sale.

XIV

INTERROGATION

A REVIEW of the literature on the polygraph (lie-detector) reveals that there is very little information available regarding the investigator's responsibility and opportunity to prepare a suspect for a polygraph interview. To a considerable degree the ultimate effectiveness of the polygraph examination is dependent upon the pre-interview handling and conditioning of the subject. Too often, investigators believe that it is necessary to introduce a "psychological fear" of the laboratory equipment. Nothing could be more removed from good procedure.

A polygraph interview is one of several forms of interrogation available to police investigators. It has many qualities in common with other interview processes, but it is distinct in that it involves the employment of laboratory apparatus to graph the subject's physical (internal) reactions to certain emotion-producing situations.

The problem of over-emotionality far outweighs the predicament of an under-reactor. The possibility of a subject becoming hyper-sensitive and generally nervous is greatly increased by threatening, exaggerating the implications of the coming experience, or by any of the methods used by uninformed persons who believe they are assisting the operator, but who, in effect, decrease the chances of success.

There are several areas in which the investigator in the field needs education with respect to conditioning the polygraph subject. These may be roughly classified as:

1. A knowledge of the technical operation.
2. An understanding of the rights (socio-ethical and legal) of the subject.
3. The correct preparation and pre-interview treatment of the subject.

A degree of understanding as to what the polygraph constitutes in terms of equipment is a desirable foundation for

handling the polygraph subject. A polygraph is a piece of apparatus consisting of various sensitive units designed to record on movable graph paper or on a meter, or sometimes on both, certain internal patterns. These patterns are usually of the breathing, the pulse rate, the blood oscillation (roughly correlated with blood pressure), and changes in the conductivity factor of the skin. All these changes are presumably accompaniments of emotion. Emotion is regarded as a state of mind or an "awareness" accompanied by motor responses. The motor responses are many and varied; they involve the adrenal glands, the circulation, gastric juices, et cetera, but of the various physical accompaniments of emotion, the polygraph usually attempts to pick up the three or four most susceptible to recording. The breathing pattern is easily established by the simple expedient of attaching to the chest some type of band or cuff by which the inhalation-exhalation tracing is achieved. The pulse rate and so-called blood pressure tracing is accomplished by a "cuff" identical to that found on ordinary blood pressure testing equipment. The changes in skin conductivity are recorded by attaching small electrodes to the finger tips, or to the hand, and then establishing a norm for that specific subject, using a low, consistent output from a dry cell battery. The output is measurable and practically constant, so that after the original balance or norm is reached any changes which are produced by modifications in the "conductivity" of the skin are recorded. This conductivity is affected by perspiration of the minute glands beneath the skin surface.

The polygraph operator is looking for internal changes as recorded by a graph or meter; these changes are presumably the accompaniments of emotion; thus it must be recognized that the operator is anxious to eliminate all extraneous sources of emotion. The ideal circumstance would be to eliminate all sources of emotion other than those produced by the key questions. Every effort of all persons handling the polygraph subject should be consistent with this objective. To effect this they must attempt to reduce or eliminate emotions resulting from fear, anxiety, guilt, and other conditions which might cloud the picture and perhaps disqualify the subject for a polygraphic interview. General emotionality is not translatable in terms of a specific offense. The highly emotional individual may yet be innocent.

The polygraph may be run continuously, but the blood pressure cuff interferes with circulation and therefore relief usually must be given every few minutes, thus the actual period for questioning a subject is limited. The polygraph interview is more prolonged than normally expected, in that it is a series of short question periods. The time factor for questioning is generally from one to several minutes. On some new equipment, there are improvements which make it possible to maintain adequate cuff pressure for longer periods of time without discomfort to the subject.

Physical surroundings are significant to the polygraph situation not only by reason of the psychological implications but also because it is necessary that the subject be seated comfortably in a chair which minimizes movement and which has facilities for the arms and hands to rest in relatively stable positions. In addition to the effects of internal changes, any noticable external movement will alter the physical connection of the equipment, as well as change pressure relationships, et cetera. The arrangements must permit the operator to control his equipment and yet observe the subject at all times. It is a good policy to maintain satisfactory quarters for polygraphic interviews. There are occasions when interviews are feasible under other than adequate circumstances, such as in outlying offices, prisons, industrial plants, et cetera, but decisions regarding these deviations from good procedure should be left to the operator rather than to some administrative officer.

The second consideration of the field investigator with respect to the potential polygraph subject is a familiarity with the subject's "rights." One of the most important of these involves the right of a subject to be interviewed by a competent polygraph expert. Mere assignment to this duty does not in itself, insure expertness. There should be a conscientious effort made to select such personnel, but also an in-service program of training for the general investigative force should be maintained. When this is established, the investigator will impart to the subject his confidence in the operator.

The subject has the right to be determined fit for examination. The investigator should advise the subject that the operator will consider any factors of health, personality, nervousness,

or temperament. If the subject is given such assurance in advance his fears may be reduced.

Although interrogational efforts include persuading the subject to accept the examination, there should be no hostile reaction expressed if the subject appears reluctant. This attitude may cause further anxiety, and may bring him to the operator in a "wrought up" state. The operator is probably best equipped to overcome the subject's unwilling attitude. Although investigators may regard resistance as an indication to guilt, this is not always the case, and furthermore it is not good procedure to suggest such. The most effective approach is to assure the subject that the polygraph has eliminated many persons from criminal accusations and is predominantly for the purpose of establishing innocence rather than indicating guilt, and the investigator should honestly believe this. The polygraph not only saves the investigators many hours of "legwork," but it also relieves many persons from the embarrassing side effects of an extensive investigation. The polygraphic elimination is relatively quick, painless, and often minimizes or eliminates the effects of publicity. Many subjects are processed through the polygraphic interview so quickly and discreetly that they are released before their involvement becomes a matter of news interest. This aspect is worth explaining to prospective interviewees. When they see that real benefits to them are possible, they may be less reluctant. In case a subject persists in objecting to the polygraph, it is best to have the operator interview him and attempt to persuade him to cooperate before manifesting any displeasure or suspicion. Many times the operator is able to create a rapport which was absent from prior relationships. Success will seldom follow if the subject is made antagonistic.

An elementary understanding of the polygraph method will deter investigators from discussing critical elements of the case with suspects. For reasons which escape most professional interviewers, many police interrogations involve the phenomenon of the police giving more information than they receive. Avoidance of loaded data is imperative for the polygraph, and there is no valid purpose for revealing information. True interviewing seeks only to obtain information which is the possession of the subject. It should not be a session in which the subject develops a great

knowledge of the case. When we ask direct questions we are actually supplying factual information to the subject. This is not good interrogational procedure, and it is usually fatal to the polygraphic interview. The very successful interviewer converses with the subject. During this conversation the interviewee is led into areas of interest to the interviewer. An atmosphere is created which permits the subject to give information, sometimes even inadvertently. If the subject fails to do so, a more direct effort may be necessary. Again, the purpose is to learn, not to inform. This is not critically required by the polygraph, but the principles are constant for most interrogations. The error is merely brought more sharply into focus if the polygraph is later used.

In considering the subject's rights, the investigator must not overlook the benefits the subject may obtain from the interview. Everything the interviewee says or does is of course subject to the general rules which govern evidence admissibility. The mere fact that the subject is involved in a polygraphic interview or is actually undergoing a polygraph examination does not of itself make his statements, comments, answers, or other expressions inadmissible. Everything which would be admissible under ordinary circumstances remains admissible. The interpretation of the graph and the expert's opinion are excluded except by stipulation. Accusatory statements, partial admissions, and a host of other legal and potentially evidentiary items may be obtained from the interview despite the fact that the examiner's opinion may not be given in court.

Lastly, it is imperative that the field investigator recognize not only the negative aspects of his handling of the potential subject, but also that the positive benefits not be obscured. Much helpful conditioning is possible from the very outset. If the investigator's conduct and attitude is fair and impersonal, it will assist greatly. If police personnel could accept the fact that there are other interview forms besides direct interrogation, with its obvious insistence and implied hazards, they might learn that the other methods prove more efficient. The free conversation form of interview is not only more pleasant to conduct but frequently more productive. In addition, there are benefits to be obtained from a modified form of the adjustive type interview. The vast majority of persons handled by the police are not con-

victed of crime. These persons form strong opinions of law itself as a result of the impression made upon them by the individual officer. Let this impression be one which will increase general respect for the legal system and for the individual officers within that system. If a large per cent of police personnel time is engaged in interview procedures, it well behooves the police to develop the most effective methods of using that time. They must not lose sight of the fact that most people make their assessments of the police on the basis of personal experience. Let that experience be one which reflects creditably upon the judgment and dignity of the agency and therefore of law itself.

If conversation regarding the polygraph or laboratory methods is involved, it is well to speak conservatively about the organization's reputation for competence and integrity. Understatement is an effective means of obtaining approval. The subject should be assured that he is about to be interviewed by an individual or a section which will do everything possible to see that his case is handled scientifically and fairly, that this process is to establish truth and is not an ingenious device to advance the police hypothesis, that this unit approaches each matter without pre-conceived notions or a tactical advantage over the subject. One should increase, if possible, the subject's impression that through this method complete truth and unbiased data may be obtained. The subject should understand that a minimum amount of questioning and discussion of the details of the case was deliberate so that he would not be informed about areas he might not otherwise know about. One should further explain that any knowledge the subject has regarding the matter should be discussed in advance so that all may understand exactly how much each person knows and why. The field investigator might do well to encourage the subject to discuss the case freely with the polygraph operator. This attitude of permitting another person to obtain data will impress the subject with the investigator's confidence in the polygraph section. It will also reduce the possibility of the investigator overdiscussing certain critical aspects of the case to such a point that a subsequent polygraph interview might be impaired.

The essence of handling a subject prior to a polygraph interview is in a method which would:

1. Inspire his confidence in the organization and the investigator.
2. Lay foundation for accepting the competence and perspective of the polygraph section.
3. Not inform the subject regarding elements of the offense which he might not otherwise have known.

Many a subject's actual source of information is the investigator himself, thus the subject has the right to claim that his knowledge was obtained from the officer. This same rule of informational discretion might well be chosen as a guide to all interviews, irrespective of polygraph possibilities.

The investigating officer must understand that in many instances it is not possible for the laboratory interviewer to render a positive analysis. This problem is often occasioned because the subject was so well informed regarding the matter that it became impossible to ascertain the origin of his data. The operator reports that the subject is or is not a suitable subject for the test. The reasons for this classification are many, and may lie outside the influence of the police (health, mentality, et cetera). He may be unsuitable, however, because of the way he has been handled. Too prolonged an interrogation, which produced adrenal exhaustion, or resulted in general nervous tension, or gave him too much information, may have made it almost impossible to interpret his responses. If the operator finds that the subject is suitable for an interview he may report the results as suggesting either that subject is not culpably aware of critical data and is not responsive to significant questions—therefore the operator clears the subject—or that the subject is reactive to critical data and significant questions. If the subject explains these reactions in a manner that suggests investigative assessment, and if the explanation is satisfactory, the subject is regarded as cleared; should the subject either refuse to explain his reactions to the operator, or should his explanation fail to be satisfactory, the subject is reported as being a suspect.

The polygraphic interview, while unusual in its method, is not unique in terms of handling or preparation. The fundamental rules of interview methods prevail, and it is prudent for any progressive police agent to educate himself in this field. Interview skills, as such, are being identified more and more for the

prominent part they play in daily action. The basic knowledge and sources of skills are available to the student. These same skills, carried a step forward, are involved in the polygraphic interview. This interview, however, is strongly dependent upon the preparation and handling by police personnel. This process should implement the department's effort rather than sabotage them.

This boils down to some relatively simple do's and do nots:

Do Not

1. Do not assume a belligerent or patronizing attitude; this may provoke antagonism and emotionality, which, in turn, may obscure specific reactions.
2. Do not permit personal distaste nor individual attitudes to show, as this may set up anxieties regarding the ability of the investigation to maintain "objectivity," which is the goal of the police agent. Over-friendliness is as undesirable as hostility. Aspire to true objectivity.
3. Do not threaten the subject with a laboratory test which "will damn well prove you out," et cetera.
4. Do not indicate that a laboratory test is a "quick" way to get to the facts. Laboratory methods are not always "quick," and further, people do not trust quick solutions of difficult problems.
5. Do not exhaust the subject either physically, which endangers the legality of the process, or emotionally, which involves legality and "nervous capacity." This is not an "ordeal" measure.
6. Do not, above all, discuss "pertinent" or intimate details of the case. Do not fall into the too familiar investigative pattern of "let's review the facts," which is usually a parade of information rather than a systematic review. Certainly no interview benefits from the investigator supplying rather than obtaining data.

Do

1. Do discuss quietly and objectively the subject's relationship to the matter under inquiry. Let him provide the information, the interrogator becoming the conversant listener.

2. Do ascertain what aspects of the matter the subject admittedly knows and what is the alleged source of his information or knowledge.
3. Do make an effort to establish in the subject's mind the complete objectivity of the investigator and the department. Impress him with an absence of any "personal" feeling regarding the matter.
4. Do ascertain, when possible, the subject's impression of his physical health, et cetera. These questions ought to be asked in order to obtain reports concerning heart, blood pressure, et cetera, before the subject is aware that the polygraph may possibly be used.
5. Do guard against over-exposing the subject to nervous or physical exhaustion which will eliminate proper use of laboratory methods.
6. Do prepare the subject for the "lab" methods by explaining in conservative terms the competency of the procedure and the excellent reputation of the examiner. Emphasize that the procedure is merely to assist the investigation to formulate intelligent and fair judgments.
7. Do conduct yourself at all times in a manner that will reflect favorably upon yourself and your organization, in the event the procedure is reviewed by higher authorities.

Case I

In the investigation of a homicide, a major police department and the prosecutor's office arranged to have two suspects brought from different parts of the country to investigative interviews. It was believed that these two men may have committed the particular offense. Neither man was presumed to know that the other had been returned, and the arrangements were for separate interviews, with a polygraph examination to follow. In this particular case there were a number of potential "key" questions. Just how many would be determined by the pre-polygraph interview. Every phase had been planned by high level personnel and the matter proceeded according to plan until suspect "A" arrived in town. He was turned over to a team of investigators as a "relief" for the agent that had travelled with the subject. In the short period of two hours, during which the subject was in the custody of the new team, he learned all about

the plan. The involved personnel were considerably disturbed by the fact that they were censored for their actions. Their defense was that they should have been warned not to discuss the matter in detail. They argued that no one had briefed them on the "secrecy" aspect of the interview. The point they missed is that under no circumstances should they have revealed the type of data which they had supplied. It is difficult to conceive of justification for such handling under any interview situation. Fortunately, the handling of "B" was skillfully conducted and the efforts were rewarded by success. The lesson, however, was obvious.

Case II

On another occasion, a theft from a boarding house involved certain unique aspects which constituted excellent material for polygraph questions. An elderly woman lost a considerable amount of money from a cigar box hidden under a bathtub in an adjoining room. She was reluctant to reveal her habits, however, and reported at first that the theft was from a bureau drawer. This information was published in local papers and was accepted in the neighborhood gossip journals. This situation gave the polygraph section a fine opportunity for question procedures. Investigators interviewing a prime suspect, however, were gradually jockeyed into a too familiar predicament. They were supplying, rather than obtaining information, and before they concluded, most of the valid keys were destroyed. Subsequent polygraph examination was of limited value due to this fact, and as a result the investigators were distracted for many days by the circumstances. Considerable effort was expended on several other suspects before other methods established the original suspect's guilt.

Case III

In many instances, however, investigators conduct the case in such fashion that all polygraph benefits are secured. In a homicide wherein an apparently innocent stranger was so near to the scene that police methods necessitated processing him, he was invited to participate in an "elimination" procedure which included a polygraph interview. This subject disclaimed any knowledge whatsoever of the circumstances, the nature of the death, the type of weapon, location of theoretical "loot," et cetera. In a relatively short time, the polygraph revealed that he in fact did recognize many of the factors, including the cause

of death, and the type of weapon used. He was then interrogated more completely, and ultimately his guilt was established. His release would have been almost certain but for his reactions to "key" questions, and those "keys" would have been invalid had not the investigating team kept secret the vital data.

Case IV

An occasion where the name of the victim alone triggered an investigation is illustrated by a case in which a young girl of social prominence was attacked. There were no actual suspects and it was necessary for the police to interview a number of persons in the area of the attack. An invitation to accept laboratory "elimination" was accepted by most of them, and finally one subject was asked the location, the nature, et cetera. His responses were somewhat exaggerated but the facts were fairly well known, and this discounted his responses. Finally, one investigator suggested using the victim's name in a list of names. The papers had not revealed the identity of the victim because of her age and family status. The investigators, in turn, had not divulged it. The subject so conspicuously reacted to the victim's name that investigators properly concentrated on his actions and succeeded in obtaining a complete confession as well as physical evidence.

Case V

In one celebrated case a suspect was being interviewed when news regarding the discovery of the "hit run" car in a remote spot was relayed to the investigator. The subject had insisted that the car had been stolen. The investigator invited the subject to respond polygraphically to a number of locations where his car might have been "ditched," and included the location recently learned. The subject responded so obviously to the exact area of the recovery that investigative efforts were concentrated and he confessed. He frankly admitted that when he heard the true location repeated in the polygraph list that he knew he was trapped.

Case VI

When a car full of young men passed and one of them threw an object at another car, striking the driver of other vehicle in the head and causing an accident which resulted in two deaths, many subjects were investigated and interrogated at some length without ever identifying to them the exact nature of the object

thrown. The newspapers in this instance had not learned the identity of the item, and therefore an excellent "key" was available. Finally one subject reacted so strongly to the general nature of the object—a specific type of bottle—that investigators went to work. Five hours later the principal and the six youths involved were in custody and had confessed.

The success of any of the thousands of polygraph cases can be laid partially, if not almost completely, to the excellent handling of the subject by the investigators.

XV

POISONS

Homicides by means of poison are often difficult to detect and for that reason many go unsolved or even unsuspected. Visual symptoms indicating a poison may approximate those caused by some systemic ailment, thus there is little wonder that when death does occur it is written off as "due to natural causes." This is especially true when there is nothing to throw suspicion on the case.

Many times a poison may be administered in small doses, none of sufficient size to cause death, yet enough to make the victim violently ill after each ingestion. Even if the family physician is called, he may, because of lack of suspicion on his part, erroneously diagnose the ailment as a stomach upset, ulcers or some other common ailment. After two or three such attacks and if, due to the cumulative action of the poison, the patient dies, the physician may, without hesitation, sign the death certificate.

Another loophole in the system is often brought about by inadequate autopsy facilities. This is especially true in many smaller communities in which the coroner is a mortician and not an M.D. Even though an autopsy is performed, the physician, generally having little knowledge of forensic medicine, may fail to recognize the true cause of death.

Laws in some states are too inadequate to force an autoposy when the family objects.

The poisoner relies on his cunningness to attain his objective and he may be the last one to be suspected. He will frequently attend the victim with diligent sincerity throughout the series of attacks and after death he may be the most lugubrious mourner at the funeral. All of these factors add to the difficulty of recognizing and solving the homicide by poisoning.

In a questionable death the investigator should try to obtain the following information:

1. Who will benefit, in what way, and to what extent?

2. Have there been deaths of others in the family under questionable circumstances?
3. Detailed description of all symptoms accompanying such deaths.

He should then submit all this information to a physician who is well-qualified in the field of forensic medicine and be governed by his opinion.

The type of poison used by the poisoner is often dependent upon a number of things:

1. The ease with which it can be administered (taste, smell, color, solubility).
2. Availability of the poison.
3. The type of poison least likely to throw suspicion on the killer.

All of these factors are important. When the poisoner and his victim live in the same house, he must work carefully to alleviate all suspicion from himself. Sometimes the poisoner will devise ingenious methods to accomplish his purpose. He may remove the contents of one of a number of capsules that are to be taken for some systemic trouble, and then replace this with a poison that has a similar appearance. As that specific capsule may not be taken immediately, it often gives him sufficient time to be miles away when the victim takes the lethal substance.

In one Los Angeles case the killer, knowing that the victim had a habit of taking any sample drug that he might receive, mailed him a sample package of vitamin capsules, one of which contained strychnine. Reason? He was in love with victim's wife.

In another case candy bars were found on two successive days in the mail box of an intended victim. The bars were coated with a white powder which upon analysis was proved to contain arsenic.

Law enforcement agencies frequently receive complaints from citizens who claim that someone is trying to poison them and they will submit various substances such as foods, liquors, even leaves and grass, for laboratory analysis. Generally these individuals are paranoiacs and should be handled as such. But occasionally the complaint is legitimate and if not investigated may result in a homicide later.

To cite a specific case as an example: a citizen stated in her

complaint that when she had made a coffee royal, using whiskey from a bottle in her liquor cabinet, her mouth was painfully burned even though she spit out the drink immediately. Upon analysis of the whiskey it was found to contain nearly a teacupful of sodium hydroxide (lye).

Investigating a Homicide by Poisoning

If an investigator has any suspicion that a case in question is homicide due to poisoning, he should go all out in his initial investigation. The poisoner may go along serenely believing that his act will not be discovered—not even suspected—and he will generally cooperate in every way, but the moment that he is aware that something is amiss, he will do everything in his power to hinder the investigation. He will try to cover his tracks by destroying evidence, building phony alibis, et cetera.

Furthermore, all members of the household should be removed from the premises, whether they are suspects or not. This will allow the investigator to conduct a thorough search, without interruptions, for anything of evidential value. Below are a few articles or substances that should be gathered for analysis:

1. All open foods, definitely if a meal has been in progress.
2. Medicines (liquids, capsules, tablets).
3. Receptacles which appear to have been recently used (glasses, cups, water bottles).
4. Open bottles of liquors.
5. Vomit, urine, et cetera.

The investigator should try to obtain the following information:

1. Interval between last food taken and:
   a. First poison symptoms.
   b. Death (if such occurred).
2. Nature of first symptoms.
3. Whether any of the following symptoms were present:
   a. Vomiting, purging.
   b. Deep sleep.
   c. Tingling of skin and throat.
   d. Convulsions or twitching.
   e. Delirium—clutching at imaginary objects.
4. Nature of any other symptoms.

5. If others ate food, what their symptoms were.
6. Any statement made by the victim as to his physiological reactions.

The above information may give the chemist some clue as to the type of poison taken, thus greatly aiding him in his analysis.

Classification of Poisons

1. Volatile poisons
   a. Phenol (carbolic acid)
   b. Chloroform
   c. Phosphorus
   d. Chloral hydrate
   e. Hydrogen cyanide
2. Alkaloids and hypnotics
   a. Strychnine
   b. Nicotine
   c. Cocaine
   d. Heroin
   e. Morphine
   f. Atropine
   g. Delaudid
   h. All barbituric acid derivatives
   i. Chloral hydrate
   j. The sulphones
   k. Paraldehyde
3. Heavy metals
   a. Arsenic
   b. Antimony
   c. Mercury
   d. Copper
   e. Lead
   f. Silver
4. Acids
   a. Sulphuric acid
   b. Nitric acid
   c. Picric Acid
   d. Hydrochloric acid
   e. Oxalic acid
   f. Hydrofluoric acid
   g. Acetic acid
5. Alkalies
   a. Sodium hydroxide (lye)
   b. Potassium hydroxide (caustic potash)
   c. Ammonium hydroxide
6. Poisons requiring special techniques in analysis
   a. Curare
   b. Botulinus toxin
   c. Cantharides
   d. Other food poisoning

The lethal dose of a poison may depend upon a number of things:

1. The health of the individual.
   A person in excellent health may survive a dose of poison that would kill one suffering from some systemic disorder.

2. State of poison (gas, liquid, powder, crystal, et cetera). The rapidity with which a poison enters the blood stream is dependent to some extent on the physical status of the poison. The longer it takes to enter the blood stream the greater are the chances that it can be eliminated from the body through purging, diarrhea, et cetera.
3. Condition of stomach, whether full or empty. A full stomach dilutes the poison and retards absorption, thus limiting its effect to some extent. It is also true that a certain food may act as an antidote by combining with the poison, thus causing it to be eliminated through the intestinal tract. Example—egg albumin and a heavy metal.
4. Method of administering.
    a. Hypodermic injection is the most rapid, as it goes directly into the blood stream.
    b. Absorption from lungs is nearly as rapid as when administered hypodermically.
    c. Absorption from the stomach is slow (strychnine is an exception).
    d. Absorption from vagina or colon is slow. (A number of accidental deaths have occurred through the use of a mercuric chloride solution as a douche.)
5. Habit. Habitual use of certain poisons may build up a tolerance in an individual to such an extent that he may survive a dosage which would be fatal if taken by another. A drug addict may inject intravenously two or three grains of morphine at one time. This amount would probably be lethal to a non-user.
6. Age. Children are highly susceptible to opiates.
7. Personal idiosyncrasy. Some individuals may be allergic to a substance that would have no effect on another. For example, not all persons can take some of the antibiotics without reacting violently to them. Also, some persons are allergic to certain foods. The author was present when an eighteen year old girl reacted almost fatally from eating watermelon. The tongue swelled until it completely filled the mouth,

and had to be depressed with a teaspoon to permit breathing.

8. Cumulative action.

   A number of poisons such as digitalis, barbiturates, and some of the heavy metals may be cumulative and when taken, even in small amounts, may eventually become lethal.

Physiological disposition of a poison after injection:

1. A poison may be thrown out—vomiting, diarrhea, et cetera.
2. If not eliminated in this manner it will pass on to the liver, which may modify or destroy it.
3. If the liver is unable to cope with the poison it then enters the blood stream and is carried to the tissues, causing damage or death.
4. If the victim survives the posion it is then eliminated through the kidneys.

DISCUSSION OF SOME OF THE MORE COMMON POISONS

Arsenic

In cases of homicide by poison, arsenic lends itself admirably for the purpose. It is easily available as it is found in ant paste, garden sprays, and in rodent controls. It is tasteless, thus creates no suspicion in the victim. Its symptoms approximate those of stomach ulcers and it is cumulative in the system.

It has one disadvantage in that it is not volatile and may be identified in the cadaver many years after death.

As little as two or three grains of arsenic have been lethal although victims have survived much larger doses. When the stomach is full, symptoms of poisoning may not appear for an hour or more. Symptoms are nausea, vomiting, and faintness. The vomit is usually bile stained. Arsenic may be detected even small quantities by the Gutziet test.*

The Reinsch test is a good indicative test for a number of the heavy metals, although it is not specific.

Reinsch Test

Place one or two ccs. of the unknown in a six inch test tube;

*See *Detection of Poisons* by Autenwreith and Warren.

acidify with HCl; insert a polished strip of copper, one quarter inch wide and seven inches long. Hold over burner and boil for a minute or two. If the following metals are present they will plate out on the copper—arsenic, antimony, mercury, and silver.

Antimony

Antimony is not commonly used in homicides but it may be taken accidently or by suicides—most common source tartar emetic. The symptoms are a metallic taste in the mouth, burning in throat and stomach, violent vomiting, and diarrhea. Toxic dose—ten grains have proven fatal. When H_2S is bubbled through a dilute solution of antimony an orange precipitate is formed.

Mercuric Chloride

Mercuric chloride is commonly available in many homes as sterilizing or disinfectant tablets. It is very toxic—two to five grains may be fatal. The symptoms are a metallic taste in the mouth, vomit bloodstained. The Reinsch test may be used as an indicative or eliminative test. Spectrographic analysis is specific.

Strychnine

Strychnine is another posion that is easily available. It may be found in poison grain used to kill rodents. It is bitter to the taste and is very fast acting. It is highly toxic—a dose of one half grain is generally lethal. It is fairly stable and may be identified in a cadaver a number of months after death. It is easily absorbed through the stomach wall and symptoms appear within a few minutes, generally followed by death within a short time. If death is going to occur, it is exceptional for a victim to live more than two hours after ingesting the poison. The victim may complain of a difficuly in swallowing, followed by twitching of the muscles. Spasms may be brought on by touching. Strychnine is an alkaloid and will react to Meyer's and Wagner's reagents. The following is a good color test:

Using a spot plate, dissolve a few crystals of potassium dichromiate in concentrated sulphuric acid; to this add a crystal of suspected material; if positive it will give a lavender color.

Yellow Phosphorus

Yellow phosphorus may be found in rodent poisons. It is

very toxic—two grains have proved fatal. It is not commonly used in homicides. The symptoms are a garlic taste in the mouth and a garlic odor to the breath. The victim complains of burning in throat and stomach. Vomit may be dark in color. Death may not occur for two or three days or even longer.

Phenol (Carbolic Acid)

This poison is not commonly used in homicides because of its recognizable odor and color but its use is quite common as a means of suicide. It is often used as a disinfectant and may be found in many homes. A half ounce of pure phenol will generally cause death.

Other Poisons

Other poisons commonly found around the home may prove fatal if taken internally. Some of these have a deleterious effect even when they come in contact with the skin or are breathed into the lungs; especially is this true when the substance is suspended or dissolved in an oil or a solvent.

Weed killers, insect sprays containing DDT, et cetera, carbon tetrachloride, paint thinners, black leaf forty (nicotine), paris green (arsenic), and copper sulfate (blue vitrol) may cause severe systemic upsets or even death.

Acids and alkalies are seldom used in homicides as they are too easily detected by the potential victim. Thus when a death does occur from a poison of this group it is generally suicide or accidental.

The potential suicide may use any means at his disposal to consumate his objective. In one case observed by the author a man committed suicide by drinking a half pint of battery acid (sulphuric acid). The autopsy disclosed the stomach as a black carbonized mass. Even the throat and mouth had a charred appearance. DDT, lysol, phenol, lye, et cetera, have been taken in suicide attempts, and they are generally successful.

Frequently in assault cases an alkali or an acid is thrown in the face of the victim, generally causing severe damage to both tissue and clothing. Wool clothing is more resistant to an acid than to an alkali. An alkali will generally leave a white residue: acids do not. Nitric acid and picric acids leave a yellowish stain.

Stink Bombs

In labor disturbances, stink bombs may be thrown or dropped in business establishments, causing considerable discomfort to all present. They generally contain one of two ingredients: Ethyl mercaptan or valeric acid. Ethyl mercaptan has the odor of decaying cabbage. It leaves a white residue and is very difficult to eliminate. Valeric acid has a disagreeable odor which is easily recognized. It may be neutralized to some extent with sodium bicarbonate, which may then be picked up by a vacuum cleaner. When clothing is impregnated with an acid, alkali, or other chemical and is to be used as evidence it should be placed in a one quart or a half gallon fruit jar and sealed with red sealing wax. The investigator should place his thumb imprint in the seal.

XVI

LATENT PRINTS

THE TERM "latent" means hidden, not visible, not apparent. For the purpose of police terminology and usage, however, a latent print (visible or invisible) is one which is obtained in connection with an investigation involving identification.

A latent print may be defined as the anatomical record, made by bodily contact, of and from the crests of the papillary ridges which are located on the palmar and plantar surfaces of the body.

The delicate sculptured skin design prints in the same manner in which a rubber stamp prints. Perspiration, the sebaceous secretion from hairy portions of the body, or other foreign matter on the skin serve as the "ink" of a latent print.

Three general types of friction ridge prints may be obtained in connection with an investigation: visible, plastic, and latent.

Visible prints are those which have been made by transferring a foreign colored substance, such as ink, blood, grease, or dust, from the crests of the papillary ridges to the object touched.

Plastic or moulded imprints, also readily discernible, are depth impressions of the ridge design in a soft, pliable medium such as putty, thick dust, envelope or stamp adhesive, friction tape mucilage, blood, grease, or soap.

True latent prints are those which are made by the natural skin secretions such as perspiration, sebaceous oil, or by some colorless foreign substance.

Under ordinary conditions this type of print generally is invisible, conforming to the dictionary definition of the word "latent."

Although there are numerous texts available, and although many departments conduct candidate and in-service training programs which cover the subject, the number of uniform personnel and *experienced* investigators who are not aware that an absolute identification may be effected from a print made by a finger joint, palm, toe, or sole is utterly astounding—and this

exists at the time when law enforcement is making great strides toward professionalization!

This oversight may be due, in part, to the frequent use of the term "fingerprint," which may have been employed by literary license to include the other identifiable friction ridge areas of the body.

While it is true that more latent fingerprints are obtained in criminal investigations than are any other papillary skin areas, it should be borne in mind that *any* palmar or plantar skin design will serve to positively identify a person, and that all said areas have been accepted and recognized by the courts as being equally conclusive evidence of identity.

In Los Angeles, over 30% of all latent prints which were identified as having been left by the perpetrator were palm prints. A considerably lesser percentage were prints of the phalanges. In a few rare instances, toe or sole prints were obtained and were identified.

In order to further prevent undue and perhaps misleading emphasis being placed upon fingerprints as *the* means of identifying a criminal, the present work refers to this type of evidence as friction ridge, papillary, or latent prints.

Frequently a latent print is the only evidence available which will serve to identify a perpetrator with his crime.

The identification, apprehension, and successful prosecution of numerous criminals, both in the United States and abroad, have been effected solely because a small friction ridge print was obtained during the investigation.

The testimony offered in these cases, unsupported by other circumstances and uncorroborated by additional evidence, has been upheld by the highest courts of the land. Many such prosecutions have resulted in death penalties.

Searching for Prints

A thorough search of the crime scene should be conducted, and recovered evidence should be examined in an effort to secure latent prints, if such are present.

Theoretically, most surfaces with which the human skin comes in contact inherently are capable of retaining latent prints. There is, however, no guarantee that an identifiable print will

be left or developed on *any* object which has been touched by bare skin.

There is an erroneous impression among law enforcement officers (which even extends in varying degrees to some identification technicians) that an attempt to obtain friction ridge prints would be futile and unproductive, because of the physical nature of the object itself, or when the evidence in question has been subjected to various normally adverse conditions.

The possibility exists that these same factors may at least in some instances help preserve a print and render it more susceptible to retention and subsequent development.

The following actual case experiences are cited to emphasize the importance of processing all articles, regardless of the circumstances.

1. After dark, a thief pried open the glass windwing of a car. The glass was quite dusty. Heavy dew settled before sun-up. Later the glass was processed for latent prints with powder. A small blot, which possibly could have been made by a finger, responded. By lightly rubbing a finger contaminated with powder over this meaningless blob, the ridges of a fingerprint were revealed with excellent clarity of detail. This print was not made by the victim, nor by any member of his family. It is possible that the dew, which is often thought to render a latent print valueless, in this instance caused the substance comprising the latent print to stick tenaciously to the glass. Although the powder originally clung to the entire dirty glass surface instead of adhering only to the friction ridge pattern, the abrasive action of the rubbing finger removed the "background" grime, but left the fingerprint firmly attached to the windwing. This technique also has been successfully applied in cases involving dirty sky light glass.
2. During a burglary a piece of wood, broken from a door, fell into a puddle of water, where it lay for several hours. After being retrieved and dried, a latent print was developed by powder on the painted surface. This print was subsequently identified as having been made by the burglar.

3. A stolen car, after having been abandoned, was subjected to rain of varying intensity for more than twelve hours. The car was recovered, then was dried at air temperature. Several identifiable prints were developed with powder on the roof, immediately above the water gutter. These were later identified as having been made by the distal and proximal phalanges of the victim, a woman over sixty years old.
4. A robber bound his victim with adhesive tape carried for that specific purpose. He threw the empty, metal tape container in the toilet and urinated in the bowl. The container was later retrieved, was washed with tap water, and was then dried with an air hose. An identifiable latent print was developed with powder on the painted portion of the tape container.
5. A tomato, handled by a robber immediately prior to his crime, was processed with powder. The latent print thus obtained was subsequently identified.
6. While waiting for an opportune time to rob a grocery store, a criminal picked up an apple, which he partially ate. A latent print, developed with iodine fumes, later identified him as the perpetrator.
7. Identifiable latent prints were obtained on silver dollars by processing them with iodine fumes.
8. Under certain lighting conditions, a latent print was visible on the inner surface of a rubber glove, although rubber is a substance commonly considered incapable of retaining prints. Photographed without previously having been processed, the skin pattern was identified and was instrumental in securing a death sentence.
9. Excellent prints were developed (by using powder) on the grooved surfaces of 45 RPM plastic phonograph records.
10. A bare footprint in earth revealed sufficient ridge detail to demonstrate in court the identification of a burglar.
11. In two separate cases, the murderers had taken the precaution of wearing leather gloves. In each instance, enough of the palmar skin was bared, while the gloves were being worn, for small friction ridge areas to be

recorded at the respective scenes. In both instances, these palmar prints were absolutely the only evidence available with which to identify the perpetrators. Each criminal received the death penalty.

12. On completely charred paper, latent prints which were not visible by ordinary light were successfully photographed by exposing infrared film through a number twenty-five Wrattan filter, and by using oblique lighting.

It would be ideal if a search for latent prints at every crime scene could be conducted by a lab expert, but until such time as this becomes practical and possible, the field officer must look particularly for those surfaces which, from experience, he may expect to be most productive in retaining friction ridge evidence.

Identifiable prints have been obtained on absorbent items such as paper, very finely woven cloth, cardboard, and smooth, unpainted wood. Such non-absorbent surfaces as unpainted metal, porcelain, glass, linoleum, plastics, enamel, and surfaces painted with various mediums have retained excellent latent images. Ridge detail imbedded in modeling clay, putty, soft paint, thick dust, grease, and other soft substances often is decipherable.

Rough articles which prevent a reasonable sized contiguous area of the skin from touching the object, and those items which have a texture so approaching the width of the papillary ridges as to break their continuity, seldom reveal a legible print. Included in this category are various cloth weaves, knurled tool handles, certain bottle caps, and checkered gun grips.

An experienced criminal usually operates methodically and with a minimum of wasted effort and time. He does not, contrary to what the distraught victim may believe, promiscuously touch everything at the scene during the commission of his crime.

In order to determine if there are items which possibly may bear latent skin designs, the officer should question the victim and witnesses carefully, and should also rely upon his own observations, experience, imagination, and logical deductions.

Witnesses and victims are prone to re-enact their own actions and those of the criminal while being questioned by an officer. Continual vigilance is thus necessary, in order to prevent them from handling objects that may have been touched by the perpetrator.

While searching a crime scene for items which possibly may bear the prints of the perpetrator, particular attention should be given to the points of entry and exit and to those objects which obviously or logically may have been touched by the criminal along his route.

Often it is possible to find an article which has been moved, and which the victim has failed to mention, by noting that dust on it has been disturbed, or that the dust pattern beneath it does not match the shape of the base. Indentations in a rug also may indicate that an article is no longer in its usual position.

Being easily seen, the plastic imprints and visible prints will more often attract the attention of untrained personnel than will the true latent print, with the result that a search for objects which might bear prints is often ended too soon.

Frequently, visible prints are meaningless smears or smudges which cannot be identified. Furthermore, they may not have been made by the perpetrator. Although prints may have been present for hours or even days, distraught victims often first notice them after the commission of a crime.

Generally, more invisible latent prints than visible or plastic prints are present at a crime scene. As a matter of fact, the latter are rare by comparison.

Papillary ridge prints may be retained on the surface of non-absorbent articles. Sometimes they may be rendered visible temporarily by the moisture in breath exhaled on the object, by strong oblique light, or by a combination of both. Other prints which are on the same surface may not respond to such treatment.

It often is possible to see latent prints which are on transparent items, such as glass and clear plastic, by means of transmitted light. Prints made by perspiration and other colorless secretions and contaminants are not always retained on the surface. They may be absorbed quite rapidly by paper or unpainted wood, thus they cannot be located by the above methods.

Friction ridge prints may be permanently revealed or rendered visible by various methods of processing, which are referred to as "developing." This subject is taken up more fully in a later section of this chapter.

Many natural factors, in addition to the common intentional precautionary measures employed by criminals, may preclude or

prevent the latent print expert from obtaining legible friction ridge evidence from an object which is known to have been touched by the perpetrator, victim, or field officer.

For this reason, and because officers on numerous occasions have mistaken the texture of cloth, leather gloves, and even water spots for latent prints, the field officer should refrain from informing the victim that prints are present. To do otherwise might result in embarrassment and might damage public relations.

How to Preserve Latent Print Evidence

The success of any investigation often depends upon the actions of the first officer to arrive at the crime scene. This officer's primary objective, in so far as physical evidence is concerned, is to prevent its contamination, alteration, or destruction.

The measures to be taken are governed by the circumstances of each case. When the importance of the investigation warrants it, the scene should be roped off, the building entrances controlled, and *all* non-essential persons prevented from entering the area.

This procedure is not necessarily limited to excluding curious onlookers and representatives of the press, but when necessary, may be, and many times *should* be, extended to victims, and even to non-essential police personnel.

If a survey of the crime scene discloses that friction ridge prints may be present, the field officer must determine if an identification expert is needed at the scene or if it is more practical to transport evidence to the lab for latent print processing. This often may be decided by a telephone call. The lab expert may then suggest the best method to employ for safeguarding the evidence during transit, or for protecting the scene.

If the field officer requests a crime scene search for latent papillary evidence, and if he cannot remain until the expert arrives, he should place easily moved objects out of the reach of distraught victims, curious children, and others who may be unaware of what has occurred and who might accidentally handle the evidence. Ideally, the scene should be under police control until the investigation is complete.

Cumbersome or immovable articles should be isolated or

otherwise protected. The discretion and judgment of the officer will govern how this is to be done. The officer must bear in mind the fact that critical surfaces should be protected against heat, dust, and moisture.

In moving an article suspected of having friction ridge prints, the officer should realize that he cannot indiscriminately handle the item merely because he is wearing gloves, or is using a handkerchief or other fabric. Granted, this will prevent him from leaving his own prints, but he may destroy prints already on the object. Furthermore, the development of cloth or leather marks may cause the expert to reach the erroneous conclusion that the perpetrator was wearing gloves while committing the crime.

Whenever an officer moves an article while wearing gloves or using a handkerchief, he should tell the lab expert personally of his actions.

These factors should also be considered when an officer is "shaking down" a recovered vehicle for possible evidence. Furthermore, the officer should advise a tow truck operator how and where he may touch the vehicle. The impound garage should have available easily-read signs which can be placed on the front, rear, and sides of impounded vehicles warning persons not to touch.

In setting an object aside, the officer may grasp it by the edges or corners, so that a minimum area of his skin or glove touches it. He may pick up bottles, cups, drinking tumblers, and similar articles by placing his fingers inside the opening. He also may safely take hold of any portion of an item where the texture is approximately as rough as are his own friction ridges. Guns may be picked up by pinching the *edges* of the trigger guard.

If a lab expert has been requested to make a crime scene search for latent prints, the victim should be notified and, if possible, apprised of the approximate time the expert will arrive.

Frequently the victim is under a mental strain. In these instances, it is necessary for the officer to emphasize that all potential evidence must remain undisturbed and untouched—that if his instructions are not faithfully followed, the delicate prints may be destroyed, thus precluding the identification and apprehension of the perpetrator.

How to Transport Evidence Suspected of Having Latent Prints to the Laboratory

The uniformed officer and latent print expert frequently must exercise ingenuity and resourcefulness while preparing evidence for transportation from the field to the lab.

The following suggestions will apply to but a few of the many problems which may be encountered during an investigation. Other objects not discussed here may require different techniques, but must be treated with similar care. Common sense generally will dictate the procedure to be followed.

A liquid must be prevented from spilling or splashing onto any portion of an article which may bear a print.

Evidence should be exposed to a minimum amount of heat, air currents, dust, and moisture.

In order to prevent breakage during transit, items should be secured so that they cannot roll, fall, or bump other objects.

Friction caused by wrapping an object with paper or fabric probably will smear delicate prints and may even completely obliterate them; also, the oily or moist substance of the latent may be completely absorbed by cloth, or paper, cotton, or excelsior, thus these should not be used.

Packaging may be accomplished successfully by using strong cardboard or wooden boxes. The evidence should be held firmly in place by anchoring some portion which is least likely to have a latent print.

Broken glass may be firmly suspended in a cardboard box by penetrating the sides of the box with corners of the glass which visually are determined to be free of prints.

Bottles, drinking tumblers, and other similar items may be held in place with wooden dowels, corks, or lids which are firmly attached to the box.

Revolvers may be secured with string around the knurled grips or by inserting a pencil or a wooden dowel in the barrel or cylinder. Metal and other hard materials should not be used for this purpose.

It is extremely important that the weapon, if loaded, be placed on safety before being transported to the lab. In this instance, the

firearm still must be handled with great caution, and the print expert must be notified that it is loaded.

The law decrees that a loaded gun cannot be sent by mail, and common sense demands that it be unloaded before being booked. When it is unloaded, a record should be made identifying each cartridge and the chamber from which it came, also the relative position of each chamber at the time the gun was first discovered.

Misleading and erroneous information concerning the method of packaging and transporting papers and cardboards suspected of bearing latent prints may be found in various publications. These articles, unfortunately, infer that latent prints are incapable of being damaged or destroyed, and the reader is advised to place several such items together in one "protective" wrapping. This procedure cannot be recommended.

Whether or not a latent print remains on the surface of paper, or is partially or completely absorbed by this evidence, depends upon the nature of the secretion or foreign matter of which the latent print is composed, and upon the physical properties of the object itself.

A latent consisting entirely of perspiration may be absorbed completely and rapidly by blotting paper, by various facial tissues or newspapers, and by other similar porous materials. Theoretically, a latent print of this type will remain undisturbed and undamaged by friction for many years.

On the other hand, a latent print which is oily may be only partially absorbed by the same objects and, therefore, may easily be damaged or destroyed.

Metallic-finished papers and cardboards, the glossy side of photographs, many cigarette packages, magazines having good quality paper, and various other "slick" or "hard" surface papers and cardboards, because of printing, coloring, composition, or finish, are relatively non-absorbent. Latent prints made by perspiration or oily matter may remain on such surfaces of these objects, unabsorbed.

Papers and cardboards should be handled at a corner, with tweezers. They should be folded only when absolutely necessary, and then, if possible, along old fold lines.

All paper and cardboard must be treated with the same care

given other items of evidence. They should be carefully packaged, protected from contact with absorbent surfaces, transported with a minimum of friction, and protected from moisture, dust, and heat. If the paper contains other pertinent evidence, it should not be folded, and any processing for prints should be done only after the document has been photographed, and then only at the requst of the questioned document expert.

When papers must be stored for some time prior to an attempt to develop latent prints, or when they are to be mailed to a laboratory for processing, they should be protected from moisture by including within the package a small quantity of anhydrous magnesium perchlorate, or some other desiccant, in a porous cloth sack.

Cellophane or plastic bags or envelopes may be used advantageously to protect and transport this evidence. Documents packaged by this means may be examined with a minimum of handling, thus lessening the danger of smearing oily prints. Protection by this means will also insure that the person handling or transporting the evidence will not leave his own prints on the article.

Developing and Photographing Latent Prints

The process whereby invisible or partially visible latent prints are colored to make them discernible is referred to as "development." Various fumes, powders, and liquid chemicals are used for this purpose. Before the print can be photographed or lifted, it must be developed.

As a rule, any attempt to process the relatively distinct visible type latent print with a powder or a liquid would result in some loss or even in the complete destruction of identifying ridge characteristics. Fumes may be employed without fear of damaging the delicate print.

Visible prints usually may be photographed by ordinary techniques. Because of the color of the article and the color of the ridge pattern itself, it sometimes is necessary to use extreme oblique lighting in order to bring out the detail—the ridge pattern will appear light against a darker background or dark against a lighter background.

Plastic or moulded impressions also are readily discernible and, therefore, are photographed "as is," using oblique lighting.

The ridge patterns in these cases appear black or dark, while the background is a lighter color.

Powdering Techniques

The terms "powdering" and "dusting" refer to the technique of making powder adhere to the more or less "sticky" latent print.

Porous surfaces such as smooth unpainted wood, cardboard, and paper should not be dusted, as other methods of development invariably produce far superior results.

Experimentation will disclose those techniques which an individual will prefer for applying powders. If a particular method constantly produces legible prints, it should continue to be used. However, there are certain fundamentals which must be followed if the desired results are to be obtained consistently.

The most common mistakes made by the beginner are: failure to "dress" ("clean up") a print by further brushing after it has become visible; the application of too much powder; and incorrect brushing techniques.

The brush should be held lightly, but firmly enough to easily control the direction of brushing and to prevent it from slipping out of the hand.

After the brush has been dipped into the powder container, any excessive amount should be shaken off. A different brush should be used for each color of powder. The powder should be distributed carefully, evenly, and smoothly over the surface with the *tip* of the bristles by using short, quick, light-pressured strokes. The latent print is apt to be destroyed if the compact and relatively inflexible side of the brush comes in contact with it.

Pressure of the bristles on the surface of the article being dusted may be controlled more easily if the fingers are used to move the brush (similar to the action employed in writing) than if wrist action is used.

After the print has become visible, it should be "cleaned up" by following the directions of the ridges with the brush tip. Brushing across the papillary pattern may cause undesirable interruptions of the identifying ridge detail, or even complete obliteration. It is advisable to use a clean, powder-free brush to dress the print. This step is extremely important, inasmuch as excess

powder may so obscure the identifying characteristics as to render the print useless for identification purposes.

In some instances, when the latent print is oily, or when dirt or other substances cause the powder to adhere tenaciously to the entire surface being processed, it is not possible to remove excess powder by means of a brush. When this occurs, an attempt should be made to remove the excess powder with lifting tape. Under these conditions, the print will not be entirely removed by the tape and the latent remaining on the object may be sufficiently clear and distinct to permit identification.

There have been cases when it was absolutely necessary to lift powder from an indistinct and illegible latent print several times (using a new piece of tape each time) before an identifiable pattern was obtained.

Powder may also be sprinkled or blown with an atomizer onto an article. Treatment by this means is not as satisfactory as is the brushing technique, because it is more difficult to control the amount of powder applied. Furthermore, it is generally still necessary to "dress" the indistinct latent developed by this method.

Objects which are moist or wet naturally must be dried before any examination is attempted. This should be done at room temperature. When the humidity does not permit drying within a reasonable time, a heated building, a fan, or heat from lights may be used with care.

Several types of brushes are manufactured for developing latent friction ridge patterns with powder. Brushes designed for other work may be employed with equally productive results.

Ordinarily, two lengths of brush fibers will suffice. The comparatively short bristles of the #12 Delta 1120 or the #12 Vadun 3000 artist brush may be used safely on most surfaces.

"Slick" surfaces, as are found on highly glazed porcelain, glossy enamels, and lustrous lacquers, should be processed with a feather duster. It is difficult to obtain the necessary light pressure when the shorter, more compact bristle brushes are used. In any event, extreme care must be exercised in order to prevent destroying the ridge detail when powdering and dressing prints on these surfaces.

Developing Latent Print With Fumes, Smoke Particles, and Liquid Chemicals

Many surfaces such as paper, cardboard, and unpainted or newly finished wood, cannot satisfactorily be processed for latent prints by means of powders. For this purpose fumes, smoke particles, and liquid chemicals are employed.

The objections to "dusting" these surfaces are: (1) more or less uniform adherence of the powder to the entire article which either completely "hides" the latent print or results in a lack of sufficient contrast between the print and the powder-contaminated background; (2) inability to properly "clean up" ridge characteristics; (3) drying of the latent image through age or absorption may cause the print to lose its tackiness so that little, if any, powder adheres to the pattern; (4) the difficulty of removing powder from the object in order to employ other methods of development; (5) powders which cannot be removed may interfere with some types of document examinations; (6) it may be impossible to restore a document to its original appearance for court presentation after powder is used; and (7) powders will not develop as many latent prints on these surfaces as will other developing agents.

To become proficient in the use of various chemicals for the development of latent impressions it is not necessary that the technician possess a thorough knowledge of the chemical reactions which occur.

However, if one is to qualify during legal hearings as an expert, he, if the occasion arises, should be prepared to explain these processes in order to avoid embarrassing or even discrediting himself, his department, and his profession.

Full discussions on developing latents by chemical methods can be found in various reference works, thus the present work will simply name these methods and interested persons will be able to locate references without difficulty:

Smoke particles: used on metals

For light surfaces: burning camphor crystals produce a black print.

For dark surfaces: burning magnesium ribbon produces a white print.

Note: The smoke technique may prevent the subsequent use of other methods of developing.

Iodine fumes: used on "fresh" latent prints left on such surfaces as paper and paper products. Also used on glass, polished furniture, various finely woven fabrics, and even shiny-skinned fruit, cartridges, silver (including coins) and greasy surfaces.

For "greasy" prints: iodine fumes produce a yellowish-brown print which fades quickly and thus must be photographed or otherwise reproduced swiftly.

Note: Iodine fumes do not destroy latent prints and thus may be used prior to other methods.

Protein and Amino acids color indicators: used on paper, fabrics, and some painted metals; especially useful on older prints which usually cannot otherwise be developed. Various chemicals can be used in these tests.

(Patent rights have been filed on this method.)

Note: These methods are rather complex, and most of the chemicals used are toxic.

Silver nitrate: used on porous surfaces; reacts to the salt (sodium chloride) in perspiration which is often present in latent prints, thus frequently develops a series of dots, rather than actual friction ridges.

Produces a brown-black print.

Note: This method prevents the use of some other methods. Since silver nitrate stains the hands, rubber gloves should be worn while it is being applied. Silver nitrate will also stain some evidence, and will remove ink from blueprints, photostats, et cetera.

How to Photograph Latent Prints

All friction ridge prints should be photographed on the object before any attempt is made to lift them. The term "lifting" is used to describe the process whereby some, or all, of the substance of a print (powder, dust, blood, et cetera) is removed from the article upon which it is found, by means of some adhesive material, and the image thus "lifted" is transferred to another location.

Not only does photographing a print "as is" create a favorable

impression on the judge or jury during a trial, but sometimes a print will not lift properly, although it may be readily discernible. There are many instances when photography is the only means whereby a permanent record of a print may be obtained for future reference and identification.

Latent prints which were present on a piece of paper before it was charred by fire have been successfully photographed by exposing infrared film through a number twenty-five Wratten filter, with extremely flat lighting. It is interesting to note that these surprisingly clear and legible prints were not visible by ordinary light and that no attempt had been made to develop them, as it was not known that they were present.

In another case, several latent prints on a porous photoflood lamp carton were not visible by ordinary light. Identifiable prints were revealed when the carton was photographed using infrared film and a number eighty-seven Wratten filter. These were the only prints obtained at the crime scene, and were subsequently identified as having been left by the perpetrator.

During one sex-murder investigation, numerous latent prints were located and were photographed by using a portable quartz crystal ultra violet lamp in darkened rooms. These prints were on white enamel-painted woodwork which had begun to turn a cream-color with age and had accumulated "scum;" on a semi-glossy canary yellow enamel painted kitchen wall; on a dull dark green painted screen porch wall; and on wallpaper and plaster which had been painted a dull light-brown. The latents found on the brown paint were quite important, as the bed where the victim was discovered was against this wall.

None of the latent prints were visible by means of direct or oblique lighting. There was absolutely no indication that they existed.

Some of the prints visible with ultra-violet light appeared darker than the background, while others fluoresced. An examination of various substances on the premises disclosed that several fluoresced, including a feminine hygiene jelly and some hair dressings.

Of the many types of film and filter combinations tried (including color film), success was obtained only by exposing Royal Pan film through a number twenty-three-A Wratten filter in the

darkened room, with illumination provided by the ultra-violet light. In each instance the exposure time was one minute and forty-five seconds at f/4.5.

After photographs had been taken of the prints on the dull brown surface, the wall was processed with ninhydrin, then with silver nitrate. A few latent prints previously photographed with ultra-violet light were developed by the silver nitrate, but they did not present the clarity of detail already obtained photographically.

The chemical processing did not produce any additional prints of value, although some additional fragmentary friction ridges were observed. Because of the nature of the surface, the use of powders or iodine fumes would have been unproductive.

Afterwards, test perspiration prints were placed on the brown and yellow surfaces. These prints were clearly revealed only when viewed with ultra-violet light, and they appeared darker than the background.

It is quite possible that both types of latent prints may be revealed by this means after a considerable lapse of time, until the gradual accumulation of "scum" from the air slowly renders them indistinct and finally obliterates them.

It appears that this technique will not only prove valuable for obtaining prints which cannot be recorded or developed by other methods, but also may be successfully utilized when a crime has occurred some considerable time before being discovered.

Polarized light produced excellent results when other attempts to photograph a latent print on a colored, glazed earthenware item had failed. The interference of the cracks with the ridge characteristics was eliminated and the print, which was only faintly visible by other photographic methods, exhibited excellent clarity of detail and contrast.

With the exception of special problems similar to those previously cited, the majority of latent prints may be satisfactorily photographed by using ordinary lighting techniques together with the medium or fine grain process, commercial Ortho or pan films currently available.

The fingerprint camera, which has been designed specifically for this work, is a most useful piece of equipment. Having its own light source, it takes one-to-one (natural size) pictures. This

camera is especially valuable when many photographs are to be taken at each crime scene and when the agency conducts nummerous investigations for latent prints, for the camera is the fixed focus type.

Although possessing some flexibility in the illuminating system, the fingerprint camera is quite limited in the utilization of various special lighting techniques which may be easily employed with other cameras available in most departments. This is especially noticeable when photographing prints on curved objects, on highly reflective surfaces and, in many instances, even those prints made in dust.

Regardless of the equipment used, all photos of latent prints should be taken natural size. This procedure not only makes it considerably easier to compare a latent print with an inked print, but is less expensive. Furthermore, if the image of the latent print is small on the negative, the grain inherent in the film may destroy the clarity of the ridge detail when the latent print is enlarged to a size suitable for court demonstration of an identification.

An identification tag should be included in each photograph of a latent print. It is desirable that the following information appear in the photograph: victim's name; date and hour the photograph was taken; the address where the crime occurred; the crime report case number; the initials of the latent print expert; and some identifying data concerning the article upon which the print appears. Further information should be included in the report and on the reverse side of each lift card, giving a brief description of the object bearing the latent print (such as size, shape, and color), the exact location of the article at the scene, and the exact location of the latent print on the article. A rough drawing of the object is quite useful for this purpose. When numerous latent prints are obtained at one crime scene, it often is helpful to number or letter the identification tag for each latent print. This number or letter then may be referred to in the latent print report on the reverse side of the lift card, and on the drawing.

Complete information is essential, particularly when an identification is effected months or years later. Failure to record de-

tailed pertinent data may result in the exclusion of the prints from evidence during a trial.

When a latent print is visible by transmitted, oblique, or ordinary room light, it should be photographed before any attempt is made to develop the print. This will insure a record having the clearest definition of ridge detail and pore structure possible under the circumstances, whereas development may result in an indistinct image.

REFERENCES

Autenreith, Wilhelm, and William H. Warren. *Laboratory Manual for Detection of Poisons and Powerful Drugs.* Philadelphia: P. Blakeston's, 1928.

Bodansky, Meyer. *Introduction to Physiological Chemistry.* New York: John Wiley and Sons, Inc., 1938.

Glaister, John. *Medical Jurisprudence and Toxicology.* Baltimore: The Williams and Wilkins Company, 1957.

Gonzales, Thomas A., Morgan Vance, Wilton Helpburn, and Charles J. Umberger. *Legal Medicine, Pathology, and Toxicology.* New York: Appleton-Century-Crafts, Inc., 1954.

Gradwohl. R. B. H. *Legal Medicine.* St. Louis: C. V. Mosby Company, 1954.

Smith, Sidney. *Forensic Medicine.* Boston: Little, Brown and Company, 1955.

INDEX